ELF NONLINEAR NOISE PROCESSING EXPERIMENTAL MEASUREMENTS, PART 2 - SYNOPTIC SAMPLE OF DIURNAL AND SEASONAL NOISE VARIATION IN NORWAY

NAVAL RESEARCH LABORATORY, WASHINGTON, D. C.

29 OCTOBER 1976

NRL Report 8039

ELF Nonlinear Noise Processing Experimental Measurements,

Part 2 – Synoptic Sample of Diurnal and Seasonal Noise Variation in Norway

JOHN R. DAVIS AND WILLIAM D. MEYERS

Electromagnetic Propagation Branch
Communications Sciences Division

October 29, 1976

NAVAL RESEARCH LABORATORY
Washington, D.C.

Approved for public release: distribution unlimited.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NRL Report 8039 / 2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ELF NONLINEAR NOISE PROCESSING EXPERIMENTAL MEASUREMENTS, PART 2 — SYNOPTIC SAMPLE OF DIURNAL AND SEASONAL NOISE VARIATION IN NORWAY	5. TYPE OF REPORT & PERIOD COVERED Interim report on a continuing NRL problem. 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) John R. Davis and William D. Meyers	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Research Laboratory Washington, D.C. 20360	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS NRL Problem R07-25 Project XSB-09
11. CONTROLLING OFFICE NAME AND ADDRESS	12. REPORT DATE October 29, 1976 13. NUMBER OF PAGES 33
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Extremely low frequencies (ELF)
Radio-frequency noise
Signal processing

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Using a suitable nonlinearity in the input stage of an extremely low frequency receiver can improve received signal-to-noise ratio S/N by whitening the nongaussian atmospheric noise at these frequencies. Previous studies indicate that performance of simple clippers, carefully adjusted on the basis of the raw noise amplitude statistics, is very nearly equal to that of the optimum clipper.

A collection of ELF noise data for all seasons and nearly all times of day has been acquired at a receiving site in the auroral zone near Tromsø, Norway. These data have been used to evaluate

(continued)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-014-6601

20.

the improvement in S/N that can be expected from simple clipping under a variety of noise and propagation conditions.

A regular diurnal variation in effective (processed) noise level is observed under quiet conditions. Under both quiet and noisy conditions little performance difference is observed among processing channels with clipping levels as far apart as 6 to 18 dB, in the vicinity of the optimum clipping level.

The nonlinear processing method described in this report provides at least 10 dB of S/N improvement over the performance obtained without suitable processing.

CONTENTS

ELF NONLINEAR NOISE PROCESSING EXPERIMENTAL MEASUREMENTS, PART 2 — SYNOPTIC SAMPLE OF DIURNAL AND SEASONAL NOISE VARIATION IN NORWAY

INTRODUCTION

This report contains the results of a detailed study of the effectiveness of nonlinear noise processing in improving extremely low frequency (ELF) signal-to-noise (S/N) ratio in all seasons and nearly all times of day, for data collected in northern Norway between January 1974 and November 1975. The method used is described by Meyers and Davis [1]. It will be summarized here for the reader's convenience.

Atmospheric noise at ELF is approximately log-normally distributed within the 10% and 90% exceedence limits, but at higher noise levels it depends on local thunderstorm activity [2, 3] and is generally more intense than Gaussian noise of the same rms level. For this reason, it is attractive to place a controlled nonlinearity in the receiver at wide signal-plus-noise bandwidth to improve signal-to-noise ratio by whitening the noise. An earlier investigation has shown that a simple clipper operating between the 10% and 40% exceedence levels in a 140-Hz bandwidth centered on 70 Hz provides near-optimum performance [3].

It is important in estimating communication system performance to characterize the noise environment; we made a synoptic collection of ELF noise data in Norway to permit quantification of the variability of effective (i.e., whitened) ELF noise under a wide range of noise and propagation conditions. Data were recorded on analog magnetic tape in a bandwidth extending from 2 to 130 Hz, together with a low-level calibration signal of high stability, to serve as an indication of S/N improvement. This calibration signal was set below clipping level, at about -140 dB below 1 $A/m \cdot Hz^{-1/2}$ (henceforth designated dBH) which represents the level below which further clipping was seldom expected to be necessary.

Details of the signal processor are reported by Meyers and Davis [1]. The analog tapes were replayed at increased speed through a bank of six clippers whose clip levels were separately successively by 6 dB. The outputs were recorded on digital tape for computation of effective noise levels, selection of best clipping levels, and calculation of signal statistics. Spectral analysis was used to identify coherent interference bands that occasionally appeared above levels intended to be clipping thresholds, and these bands were removed by notch filtering.

Manuscript submitted July 15, 1976

DATA

Data are presented here for four one-month recording periods. All data were recorded in Tromsoφ, Norway (lat. 20°E, long. 70°N), a location representative of auroral-zone conditions to be expected in a belt extending eastward from Novaya Zemlya, through northern Norway and the Norwegian Sea, to Iceland and the southern tip of Greenland.

Figures 1 and 2 and Tables 1-5 contain data from January 1974, in a form intended to emphasize (1) the bounds of diurnal variation, (2) the day-to-day variability, and (3) the effectiveness of the multiple clipping levels in reducing effective noise for these variable conditions. Similar illustrations will appear below for data acquired during the other three seasons, so that seasonal variation can be assessed.

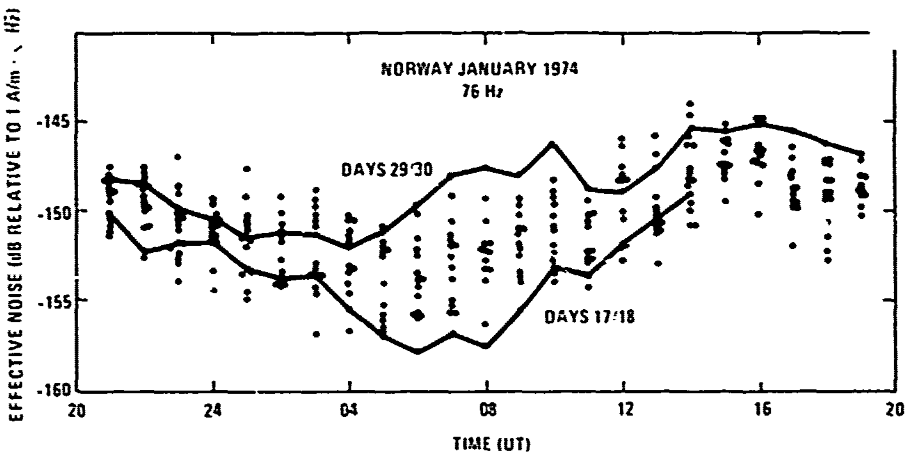

Fig. 1—Hourly samples of minimum effective noise, each averaged over 13 min, for January 1974. The quietest and noisiest days of the month are graphed and designated by Julian day numbers.

Figure 1 is a scatter plot of hourly samples of the minimum effective noise data (each sample of 13-min. duration) taken during this measurement period. By minimum effective noise is meant the noise output of the clipper that provided the greatest improvement in S/N of the six parallel-processed channels. Effective noise is defined as the ratio of the known injected calibration signal level to the measured S/N after clipping. Postclipping S/N was determined by computing the ratio of mean-square signal to signal variance after 13 min of coherent integration. The data in this report represent effective noise at a center frequency of 76 Hz (i.e., the injected calibration signal used for a reference was at 76 Hz). Superimposed on the scatter plot are two lines that represent the noisiest day (days 29/30) and the quietest day (days 17/18) of the month. The Julian day number designation will be used throughout this report—in this case, two day numbers appear in each citation because data tapes extended across midnight Universal Time (UT).

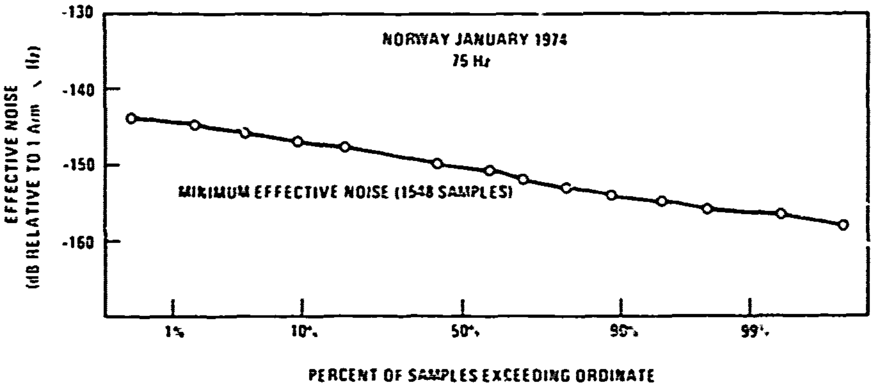

Fig. 2—Cumulative probability distribution of minimum effective noise samples for January 1974

The diurnal variation of about 6 dB in mean noise from a minimum at 04-08 UT to a maximum at 14-18 UT is evident in Fig. 1. It is worthy of note that the disparity between the noisiest and quietest days of the month is greatest in the 06-10 UT interval, when the sunrise terminator passes over the receiving site and regions south, producing instability in ionospheric conditions that affects the propagation of noise northward from more southerly latitudes. This disparity probably is more evident in these winter data than in data from other seasons because the trajectory of the terminator approaches the receiving site more rapidly and from farther south in the winter. Its effect on noise propagating northward is thus more pronounced.

To describe noise conditions indicated by the noisy- and quiet-day extremes in Fig. 1, Tables 1-4 contain information on the individual 13-min noise samples that make up each of these days' data. Table 1 contains 84 samples from the quieter day, tabulated by Julian day number and UT. The six columns represent effective noise in dBH for five of the six signal processor channels in inverse order of clipping vigor, with the minimum of the six effective noise levels in the right-hand column. As a matter of convenience, the sixth clipper output is not shown (not enough columns were available on the computer output printer), but this clipper was never the best one. The clipping levels used in these and other cases to be discussed below were -116 dBH (Column 5) to -140 dBH (Column 1) in 6-dB increments.

The minimum effective noise level for each sample is also boxed in its appropriate clipper's column so that temporal variation of optimum clipping level can readily be observed. Two important points can be inferred from Table 1:

- There is a gradual, systematic, 12-dB variation in best clip level with time, presumably following the diurnal changes in noise conditions.

- The difference in effective noise level among columns 1-3 is seldom more than a few tenths of a decibel.

Table 1 -- Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 17 and 18, 1974 (Quiet Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (dB RELATIVE TO 1 W m^{-2} Hz^{-1})					
			1	2	3	4	5	MIN
1	017	20 31 33	151.2	-151.3	-151.5	151.5	150.4	-151.5
2	017	20 44 39	-151.0	151.4	-151.3	-151.6	-149.6	-151.4
3	017	20 57 45	-150.9	-151.1	-151.2	-151.1	-150.1	-151.2
4	017	21 10 52	-150.4	-150.7	-151.0	-150.5	149.2	-151.0
5	017	21 23 58	-150.7	-150.5	-150.8	-150.6	-149.7	-150.9
6	017	21 37 05	-151.1	151.2	151.3	151.1	-149.9	-151.3
7	017	21 50 11	-152.3	152.1	152.3	-152.1	-151.0	-152.3
8	017	22 03 17	-151.7	151.7	-152.1	-152.0	150.7	-152.1
9	017	22 16 23	151.9	152.1	152.1	151.7	150.7	-152.1
10	017	22 29 30	151.4	152.1	152.1	-151.4	150.5	-152.1
11	017	22 42 36	-152.2	-152.0	-152.0	-151.9	150.6	-152.2
12	017	22 55 42	151.8	151.7	151.8	-151.5	150.5	-151.8
13	017	23 08 49	-152.6	152.6	153.0	151.8	-150.3	-153.0
14	017	23 21 55	151.4	151.7	151.8	151.5	150.0	-151.8
15	017	23 35 01	-152.0	151.7	152.1	-151.1	150.1	-152.1
16	017	23 48 07	151.6	151.6	152.0	151.5	150.1	-152.0
17	018	00 01 14	151.6	151.6	151.6	-150.7	149.4	-151.8
18	018	00 14 20	152.6	152.3	152.4	151.6	150.3	-152.6
19	018	00 27 26	-152.2	151.9	-152.1	151.6	-150.0	-152.2
20	018	00 40 32	152.3	151.9	-152.2	151.5	150.4	-152.3
21	018	00 53 39	-153.4	153.0	-153.3	-151.9	150.5	-153.4
22	018	01 06 45	-153.6	152.9	153.3	-152.3	-150.9	153.6
23	018	01 19 51	-152.9	152.6	-153.1	152.3	150.8	-153.1
24	018	01 32 57	-152.2	-152.1	-152.5	-151.9	-150.7	-152.5
25	018	01 46 03	152.5	152.7	153.1	151.7	150.4	-153.1
26	018	01 59 10	153.8	-153.2	-153.6	-152.5	-151.4	-153.8
27	018	02 12 16	154.3	153.6	154.1	152.9	-151.0	-154.3
28	018	02 25 22	-153.1	-152.4	153.3	152.6	-151.3	-153.3
29	018	02 38 29	152.3	151.4	152.8	151.5	-150.9	-152.3
30	018	02 51 35	153.5	153.0	153.5	152.6	-151.0	-153.5
31	018	03 04 41	153.6	151.2	153.6	152.6	151.4	-153.6
32	018	03 17 47	-153.0	152.7	153.1	152.0	-150.9	153.1
33	018	03 30 53	-154.4	153.2	153.4	152.4	151.1	154.4
34	018	03 44 00	-154.7	153.4	154.6	153.0	-151.6	-154.7
35	018	03 57 06	-155.5	154.2	154.7	153.3	-151.4	-155.5
36	018	04 10 12	155.3	153.7	154.2	152.6	-151.4	-155.3
37	018	04 23 19	155.7	153.6	-154.6	152.9	151.4	-155.7
38	018	04 36 25	156.1	154.5	155.3	153.7	-152.2	156.1
39	018	04 49 31	156.6	154.6	155.6	154.1	152.2	-156.6
40	018	05 02 37	156.9	154.4	155.5	153.8	152.5	-156.9
41	018	05 15 44	156.8	155.7	156.5	154.5	152.9	156.8
42	018	05 28 50	154.9	153.9	155.3	153.7	152.6	-154.8
43	018	05 41 56	154.5	154.1	155.2	153.6	152.2	-154.5
44	018	05 55 02	157.9	154.7	155.4	153.7	152.4	157.9
45	018	06 08 09	154.5	154.1	155.2	154.3	152.9	154.5
46	018	06 21 15	154.3	154.3	155.5	154.0	152.6	154.3
47	018	06 34 21	157.5	154.5	155.4	152.9	152.4	157.4
48	018	06 47 27	154.7	154.1	155.2	153.4	152.9	154.7
49	018	07 00 34	154.4	154.0	-155.2	153.4	151.7	-154.9
50	018	07 13 40	154.5	154.5	155.6	152.9	-152.5	154.9
51	018	07 26 46	154.3	-154.6	155.4	-153.4	152.3	154.7
52	018	07 39 52	-155.5	-153.9	-154.5	-152.9	-151.5	155.2
53	018	07 52 59	155.9	154.1	154.9	153.1	152.0	155.9
54	018	08 06 05	-157.6	154.4	155.7	154.3	-153.2	157.6
55	018	08 19 11	153.7	153.5	154.2	153.5	152.6	-154.2
56	018	08 32 17	153.9	153.8	154.6	153.7	-152.0	154.6
57	018	08 45 24	154.5	154.2	155.2	153.5	152.3	154.5
58	018	08 58 30	155.6	154.1	155.1	154.0	-152.5	155.6
59	018	09 11 36	154.8	152.9	153.7	152.5	151.5	154.8
60	018	09 24 42	153.8	152.7	153.6	152.3	151.4	153.8
61	018	09 37 49	155.6	153.0	154.6	153.1	151.4	155.4
62	018	09 50 55	154.7	153.4	154.7	152.5	151.9	154.7
63	018	10 04 01	151.9	152.1	153.1	153.4	150.7	153.1
64	018	10 17 07	153.1	153.2	153.4	152.5	151.3	153.4
65	018	10 30 14	153.7	153.6	154.1	153.4	151.9	154.1
66	018	10 43 20	152.2	152.7	152.5	152.0	150.5	152.5
67	018	10 56 26	152.9	153.2	153.6	153.0	151.2	153.6
68	018	11 09 32	152.5	152.1	152.6	152.3	151.4	152.6
69	018	11 22 38	-152.1	152.2	152.5	152.2	151.2	152.5
70	018	11 35 45	151.7	152.0	152.5	152.4	151.2	152.5
71	018	11 48 51	-152.3	152.2	152.4	151.3	150.8	152.4
*72	000	00 01 14	140.9	140.7	140.9	141.0	140.7	141.0
73	018	12 14 31	151.6	151.0	151.3	150.7	150.4	151.6
74	018	12 27 37	151.6	151.4	151.4	150.6	149.4	151.6
75	018	12 40 43	150.8	150.5	150.6	149.0	149.9	150.8
76	018	12 53 50	150.6	150.2	150.2	149.7	-149.7	150.6
77	018	13 06 56	149.7	150.1	150.2	149.6	148.6	150.2
78	018	13 20 02	149.7	150.2	150.0	149.2	148.8	150.2
79	018	13 33 08	149.7	149.6	149.9	149.1	149.1	149.9
80	018	13 46 15	149.1	149.3	149.2	149.0	149.2	-149.3
81	018	13 59 21	148.6	148.5	148.3	148.3	147.6	148.6
82	018	14 12 27	148.6	148.4	148.7	148.1	147.8	148.7
83	018	14 25 34	148.6	148.4	148.9	148.3	147.6	148.9
84	018	14 38 40	143.5	142.5	143.8	143.6	146.9	146.9

*RECORDING ERROR

Table 2 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 17 and 18, 1974

	1	2	3	4	5	MIN
DAILY MEAN	-152.8	-152.3	-152.8	-151.9	-150.7	-153.2
STANDARD DEV	2.9	2.3	2.5	2.0	1.8	2.7

PROBABILITY DENSITY

-158.0	1	1.2	0	0.0	0	0.0	0	0.0	0	0.0	1	1.2
-157.0	3	3.6	0	0.0	0	0.0	0	0.0	0	0.0	3	3.6
-156.0	11	13.1	0	0.0	1	1.2	0	0.0	0	0.0	11	13.1
-155.0	8	9.5	1	1.2	16	19.0	0	0.0	0	0.0	8	9.5
-154.0	5	6.0	17	20.2	12	14.3	5	6.0	0	0.0	8	9.5
-153.0	12	14.3	17	20.2	15	17.9	18	21.4	1	1.2	13	15.5
-152.0	16	19.0	20	23.8	15	17.9	22	26.2	17	20.2	17	20.2
-151.0	14	16.7	15	17.9	12	14.3	22	26.2	23	27.4	10	11.9
-150.0	5	6.0	7	8.3	6	7.1	6	7.1	23	27.4	6	7.1
-149.0	4	4.8	2	2.4	2	2.4	5	6.0	9	10.7	2	2.4
-148.0	3	3.6	3	3.6	3	3.6	4	4.8	6	7.1	3	3.6
-147.0	0	0.0	0	0.0	0	0.0	0	0.0	3	3.6	0	0.0
-146.0	0	0.0	0	0.0	0	0.0	0	0.0	1		1	1.2
-145.0	0	0.0	0	0.0	0	0.0	1	1.2	0	0.0	0	0.0
-144.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
-143.0	1	1.2	0	0.0	1	1.2	0	0.0	0	0.0		0.0
-142.0	0	0.0	1	1.2	0	0.0	0	0.0	0	0.0	0	0.0
-141.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
-140.0	1	1.2	1	1.2	1	1.2	1	1.2	1	1.2	1	1.2

CUMULATIVE PROBABILITY DISTRIBUTION

-158.0	1	1.2	0	0.0	0	0.0	0	0.0	0	0.0	1	1.2
-157.0	4	4.8	0	0.0	0	0.0	0	0.0	0	0.0	4	4.8
-156.0	15	17.9	0	0.0	1	1.2	0	0.0	0	0.0	15	17.9
-155.0	23	27.4	1	1.2	17	20.2	0	0.0	0	0.0	23	27.4
-154.0	28	33.3	18	21.4	29	34.5	5	6.0	0	0.0	31	36.9
-153.0	40	47.6	35	41.7	44	52.4	23	27.4	1	1.2	44	52.4
-152.0	56	66.7	55	65.5		70.2	45	53.6	18	21.4	61	72.6
-151.0	70	83.3	70	83.3	71	84.5	67	79.8	41	48.8	71	84.5
-150.0	75	89.3	77	91.7	77	91.7	73	86.9	64	76.2	77	91.7
-149.0	79	94.0	79	94.0	79	94.0	78	92.9	73	86.9	79	94.0
-148.0	82	97.6	82	97.6	82	97.6	82	97.6	79	94.0	82	97.6
-147.0	82	97.6	82	97.6	82	97.6	82	97.6	82	97.6	82	97.6
-146.0	82	97.6	82	97.6	82	97.6	82	97.6	83	98.8	83	98.8
-145.0	82	97.6	82	97.6	82	97.6	83	98.8	83	98.8	83	98.8
-144.0	82	97.6	82	97.6	82	97.6	83	98.8	83	98.8	83	98.8
-143.0	83	98.8	82	97.6	83	98.8	83	98.8	83	98.8	83	98.8
-142.0	83	98.8	83	98.8	83	98.8	83	98.8	83	98.8	83	98.8
-141.0	83	98.8	83	98.8	83	98.8	83	98.8	83	98.8	83	98.8
-140.0	84	100.0	84	100.0	84	100.0	84	100.0	84	100.0	84	100.0

Table 2 contains a compilation of noise statistics for quieter day's data, showing in the upper block the daily mean and standard deviation of effective noise, both from each of the five columns and from the minimum-noise column. Notice that either column 1 or column 3 alone is within 0.4 dB of providing the minimum mean effective noise. Also shown in Table 2 are a probability density and cumulative probability distribution for all of the samples from the six columns.

Table 3 contains a sample-by-sample tabulation for the noisier day of Fig. 1. Once again there is a general diurnal shift of best clip level, but the tendency is far less uniform for this noisy day than for quiet conditions. Nevertheless, the difference in effective noise level among the columns is very small, and in only a few cases is there more than a few tenths of a decibel difference among columns 1-4. The upper block in Table 4 confirms this circumstance. The lower blocks, as above, contain statistical data for the six columns.

Table 3 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 29 and 30, 1974 (Noisy Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO 1A/m/√Hz)					
			1	2	3	4	5	MIN
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
29	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
31	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
32	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
33	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
34	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
36	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
37	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
38	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
39	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
41	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
42	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
43	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
44	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
46	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
47	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
48	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
49	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
51	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
52	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
53	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
54	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
56	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
57	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
58	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
59	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
60	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
61	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
62	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
63	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
64	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
65	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
66	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
67	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
68	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
69	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
70	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
71	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
72	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
73	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
74	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
76	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
77	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
78	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
79	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
80	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
81	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
82	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
83	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
84	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
85	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
86	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
87	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
88	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
89	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
90	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
92	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
93	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
94	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
95	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
96	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
97	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
99	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
101	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
102	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
103	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 4 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 29 and 30, 1974

	1	2	3	4	5	MIN
DAILY MEAN	-118.2	-118.4	-118.3	-118.1	-117.1	-118.5
STANDARD DEV	2.2	2.2	2.3	2.1	1.9	2.2

PROBABILITY DENSITY

-122.0	1	1.0	2	1.9	4	3.9	0	0.0	0	0.0	5	4.9
-121.0	13	12.6	15	14.6	17	16.5	13	12.6	0	0.0	17	16.5
-120.0	16	15.5	13	12.6	10	9.7	14	13.6	11	10.7	9	8.7
-119.0	11	10.7	13	12.6	11	10.7	10	9.7	14	13.6	12	11.7
-118.0	11	10.7	13	12.6	9	8.7	13	12.6	15	14.6	13	12.6
-117.0	16	15.5	15	14.6	19	18.4	18	17.5	16	15.5	17	16.5
-116.0	10	9.7	13	12.6	11	10.7	11	10.7	16	15.5	12	11.7
-115.0	21	20.4	15	14.6	16	15.5	18	17.5	21	20.4	15	14.6
-114.0	2	1.9	3	2.9	5	4.9	5	4.9	8	7.8	2	1.9
-113.0	2	1.9	1	1.0	1	1.0	1	1.0	1	1.0	1	1.0
-112.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.0	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION

-122.0	1	1.0	2	1.9	4	3.9	0	0.0	0	0.0	5	4.9
-121.0	14	13.6	17	16.5	21	20.4	13	12.6	0	0.0	22	21.4
-120.0	30	29.1	30	29.1	31	30.1	27	26.2	11	10.7	31	30.1
-119.0	41	39.8	43	41.7	42	40.8	37	35.9	25	24.3	43	41.7
-118.0	52	50.5	56	54.4	51	49.5	50	48.5	40	38.8	56	54.4
-117.0	68	66.0	71	68.9	70	68.0	68	66.0	56	54.4	73	70.9
-116.0	78	75.7	84	81.6	81	78.6	79	76.7	72	69.9	85	82.5
-115.0	99	96.1	99	96.1	97	94.2	97	94.2	93	90.3	100	97.1
-114.0	101	98.1	102	99.0	102	99.0	102	99.0	101	98.1	102	99.0
-113.0	103	100.0	103	100.0	103	100.0	103	100.0	102	99.0	103	100.0
-112.0	103	100.0	103	100.0	103	100.0	103	100.0	103	100.0	103	100.0

Table 5 contains similar statistical data from all of the 1548 samples taken during January 1974 for the five clip levels and for the sample-by-sample minimum effective noise (sixth) column. Figure 2 is the cumulative probability distribution for the minimum effective noise column of Table 5, showing evident log-normalcy for the entire body of data.

While these data are fresh in the reader's mind, it is appropriate to draw a conclusion that will be seen to be borne out by further examples to be presented below: the difference in performance between processing channels with 6-18 dB separation in clip level is small. Intelligent placement of one or two clippers at levels based on seasonal average noise levels will nearly always provide effective noise within a few tenths of a decibel of the minimum level.

Figures 3 and 4 and Tables 6-9 contain similar data from March 1974. Figure 3 shows somewhat higher effective noise levels and a somewhat less pronounced difference between noisy-day and quiet-day levels in the 06-10 UT interval. Table 6 contains a sample-by-sample tabulation of the quiet-day (days 77/78) data from Fig. 3, with once again an orderly shift of clip level among the channels with time. Toward the end of the day noise began to rise and the orderly progression among processor channels ceased. Under quiet conditions early in the day, columns 3 and 4 were separated by 0.1 to 0.4 dB in effective noise level, and as conditions became noisier toward the end of the day columns 1-4 provided similar performance. This trend of noisy conditions to equalize

Table 5 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, January 1974

PROBABILITY DENSITY

EFFECTIVE NOISE LEVEL (dB RELATIVE TO 1A m/√Hz)	1		2		3		4		5		MIN	
-1580	2	01	0	00	0	00	0	00	0	00	2	01
-1570	5	03	0	00	3	02	1	01	0	00	6	04
-1560	20	13	4	03	13	08	6	04	0	00	30	19
-1550	19	12	14	09	52	33	34	22	4	03	42	27
-1540	35	23	58	37	84	54	74	48	22	14	92	59
-1530	79	51	116	75	132	85	104	67	56	36	126	81
-1520	176	114	172	112	167	108	170	110	103	67	182	118
-1510	217	140	218	141	191	123	174	112	165	107	168	109
-1500	262	169	263	170	229	148	215	139	186	120	242	156
-1490	247	160	227	147	210	.36	248	160	245	158	207	134
-1480	185	120	187	121	179	116	197	127	255	165	180	116
-1470	135	87	129	83	128	83	155	103	231	149	124	80
-1460	79	51	85	55	77	50	85	55	148	96	83	54
-1450	52	34	45	29	54	35	54	35	88	57	42	27
-1440	21	14	16	10	20	13	20	13	31	20	16	10
-1430	7	05	5	03	5	03	2	01	8	05	1	01
-1420	1	01	2	01	0	00	0	00	1	01	0	00
1410	2	01	3	02	3	02	2	01	1	01	3	02
-1400	3	02	2	01	2	01	2	01	3	02	2	01
1390	0	00	0	00	0	00	1	01	0	00	0	00
-1380	1	01	0	00	0	00	0	00	1	01	0	00
-1370	0	00	1	01	0	00	0	00	0	00	0	00

CUMULATIVE PROBABILITY DISTRIBUTION

EFFECTIVE NOISE LEVEL (dB RELATIVE TO 1A m/√Hz)	1		2		3		4		5		MIN	
1580	2	01	0	00	0	00	0	00	0	00	2	01
-1570	7	05	0	00	3	02	1	01	0	00	8	05
-1560	27	17	4	03	16	10	7	05	0	00	38	25
-1550	46	30	18	12	67	43	41	26	4	03	80	52
-1540	81	52	76	49	151	98	115	74	26	17	172	111
-1530	160	103	192	124	283	183	219	141	82	53	298	193
-1520	336	217	365	236	450	291	389	251	185	120	480	310
-1510	553	357	583	377	641	414	563	364	350	226	648	419
-1500	815	526	846	547	870	562	778	503	536	346	890	575
-1490	1062	686	1073	693	1080	698	1026	663	781	505	1097	709
-1480	1247	806	1260	814	1259	813	1223	790	1036	669	1277	825
-1470	1382	893	1389	897	1387	896	1382	893	1267	818	1401	905
-1460	1461	944	1474	952	1464	946	1467	948	1415	914	1484	959
-1450	1513	977	1519	981	1518	981	1521	983	1503	971	1526	986
-1440	1534	991	1535	992	1538	994	1541	995	1531	991	1542	996
-1430	1541	995	1540	995	1543	997	1543	997	1542	996	1543	997
-1420	1542	996	1542	996	1543	997	1543	997	1543	997	1543	997
-1410	1544	997	1545	998	1546	999	1545	998	1544	997	1546	999
-1400	1547	999	1547	999	1548	1000	1547	999	1547	999	1548	1000
-1390	1547	999	1547	999	1548	1000	1548	1000	1547	999	1548	1000
-1380	1548	1000	1547	999	1548	1000	1548	1000	1548	1000	1548	1000
-1370	1548	1000	1548	1000	1548	1000	1548	1000	1548	1000	1548	1000

clipper performance was also evident in the January 1974 data. Table 7 contains statistical data for the data in Table 6, indicating very little difference in performance between channels 3 and 4 (although the comparison is muddied in this case, because noise conditions changed during the day).

Table 8 contains a sample-by-sample tabulation of the noisy-day (days 85/86) data from Fig. 3, showing the less orderly shift among clippers coupled with lesser performance distinction between clipper channels, which has been suggested above as characteristic of noisy conditions. A quiet interval between 00 UT and 05 UT can be discerned on Table 8 by the consistency of the best clipper choice, as well as by the low effective noise levels. Table 9 contains statistical information for the noisy-day data, confirming the extremely small variability of clipper performance among four of the five channels.

Figure 4 shows the cumulative probability distribution for the March 1974 minimum effective noise data, compared with noise measured simultaneously on a narrowband (1-Hz) recording channel without wideband nonlinear processing and averaged over a 1-h period. This comparison indicates that nonlinear noise processing provides at least 10 dB of improvement over conditions in which no prefiltering processing is attempted. However, because the narrowband noise data were recorded on analog tape with no more than 40 dB of linear dynamic range some of the highest amplitude noise pulses were

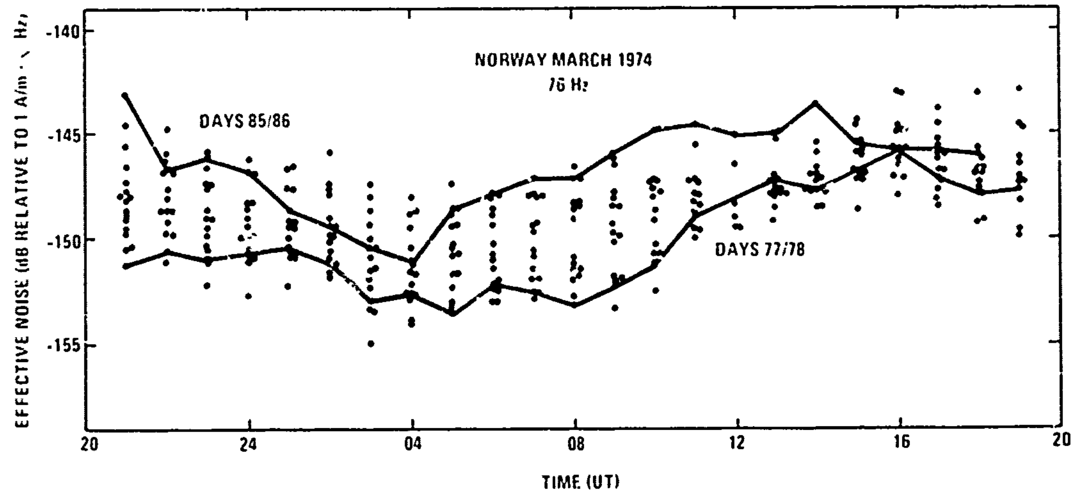

Fig. 3—Hourly samples of minimum effective noise, each averaged over 13 min, for March 1974. The quietest and noisiest days of the month are graphed and designated by Julian day numbers

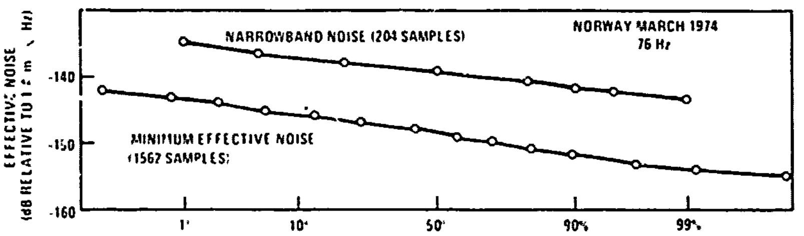

Fig. 4—Cumulative probability distribution of minimum effective noise samples compared with narrowband noise for March 1974

inadvertently clipped in the recording system, and the narrowband noise values thus are underestimated by an unknown amount. The frequency of large-amplitude noise pulses is quite low in winter conditions, when thunderstorm centers are far removed from the receiving site, and the March 1974 narrowband noise estimates are probably reliable. However, for summer conditions the opposite is true. Consequently, the tentative view expressed by Meyers and Davis [1] that improvements in S/N due to nonlinear processing are greater under low-noise (winter) conditions than under high-noise (summer) conditions is probably incorrect. It should be understood that the actual effective noise levels reported here and by Meyers and Davis [1] are correct, and only their comparison under high-noise conditions with narrowband noise estimates is of limited validity.

Figures 5-6 and Tables 10-14 contain data from March 1975. The diurnal behavior and the mean effective noise levels are similar to the March 1974 data, but the low-noise data (days 66/67) are extremely low and represent unusually quiet conditions. Table 10

Table 6 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 77 and 78, 1974 (Quiet Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO 1A/m·√Hz)					
			1	2	3	4	5	MIN
1	077	20 35 25	-148.3	-148.9	-150.2	-150.6	-149.3	-150.6
2	077	20 48 32	-148.7	-149.3	-150.7	-150.9	-149.4	-150.9
3	077	21 01 39	-149.0	-149.1	-150.7	-151.2	-149.8	-151.2
4	077	21 14 45	-148.3	-149.1	-150.3	-150.7	-149.5	-150.7
5	077	21 27 52	-148.6	-149.2	-150.6	-150.7	-149.1	-150.7
6	077	21 40 59	-148.3	-148.9	-150.3	-150.5	-149.2	-150.5
7	077	21 54 05	-147.8	-148.5	-150.0	-150.6	-149.3	-150.6
8	077	22 07 12	-148.2	-149.3	-150.8	-151.0	-149.7	-151.0
9	077	22 20 18	-148.4	-149.1	-150.8	-151.0	-149.9	-151.0
10	077	22 33 25	-148.1	-148.7	-150.4	-151.0	-149.6	-151.0
11	077	22 46 32	-148.4	-149.1	-150.5	-150.9	-149.8	-150.9
12	077	22 59 38	-148.5	-149.1	-150.6	-150.9	-150.0	-150.9
13	077	23 12 45	-148.7	-149.4	-150.8	-151.7	-150.5	-151.7
14	077	23 25 51	-148.3	-149.1	-150.2	-150.3	-149.0	-150.3
15	077	23 38 58	-149.4	-149.3	-150.5	-150.8	-149.7	-150.8
16	077	23 52 04	-148.8	-149.6	-150.7	-150.6	-149.7	-150.7
17	078	00 05 11	-148.5	-149.2	-150.6	-150.7	-149.4	-150.7
18	078	00 18 17	-148.2	-149.0	-150.7	-151.5	-149.8	-151.5
19	078	00 31 24	-148.4	-149.0	-150.4	-151.2	-149.9	-151.2
20	078	00 44 31	-148.5	-148.9	-150.5	-150.6	-149.3	-150.6
21	078	00 57 37	-147.8	-148.5	-150.0	-150.4	-149.0	-150.4
22	078	01 10 44	-148.7	-149.3	-150.7	-150.6	-149.0	-150.7
23	078	01 23 50	-148.[illegible]	-149.0	-150.4	-150.8	-149.7	-150.8
24	078	01 36 57	-148.0	-148.6	-150.2	-150.5	-149.5	-150.5
25	078	01 50 03	-149.0	-149.7	-151.4	-151.7	-150.3	-151.7
26	078	02 03 10	-148.6	-149.4	-150.8	-151.1	-149.8	-151.1
27	078	02 16 16	-149.5	-150.1	-151.5	-151.0	-149.6	-151.5
28	078	02 29 23	-149.0	-149.8	-151.2	-151.3	-150.1	-151.3
29	078	02 42 30	-150.2	-150.9	-152.2	-152.0	-151.1	-152.2
30	078	02 55 36	-150.4	-151.1	-152.9	-152.7	-151.6	-152.9
31	078	03 08 43	-151.4	-152.0	-153.5	-152.7	-151.6	-153.5
32	078	03 21 49	-152.3	-152.8	-154.5	-153.8	-152.6	-154.5
33	078	03 34 56	-151.8	-152.2	-154.1	-153.3	-151.9	-154.1
34	078	03 48 02	-150.6	-151.1	-153.2	-152.9	-152.3	-153.2
35	078	04 01 09	-150.3	-150.7	-152.6	-152.6	-151.8	-152.6
36	078	04 14 16	-150.5	-151.4	-152.8	-152.3	-151.2	152.8
37	078	04 27 22	-150.3	-150.5	-151.9	-151.3	-150.3	-151.9
38	078	04 40 29	-150.4	-151.2	-152.9	-152.6	-151.2	-152.9
39	078	04 53 35	-151.2	-151.5	-153.0	-152.0	-151.1	-153.0
40	078	05 06 42	-152.0	-152.1	-153.7	-152.6	-151.7	-153.7
41	078	05 19 48	-150.5	-151.1	-152.3	151.7	-150.5	-152.3
42	078	05 32 55	-150.6	-151.2	-152.4	-151.5	-150.1	-152.4
43	078	05 46 02	-150.6	-151.2	-152.7	-152.0	-150.4	-152.7
44	078	05 59 08	-150.3	-150.8	-152.1	-151.5	-150.4	-152.1
45	078	06 12 15	-150.5	-150.8	-152.1	-151.5	-150.1	152.1
46	078	06 25 22	-150.8	-151.2	-152.4	-151.6	-150.3	152.4
47	078	06 38 28	-150.6	-151.2	-152.5	-151.9	-150.8	-152.5
48	078	06 51 34	-150.7	-151.5	-152.3	-151.5	-150.3	-152.3
49	078	07 04 41	-151.0	-151.4	-152.5	-151.8	-150.9	-152.5
50	078	07 17 48	-150.8	-151.4	152.2	-151.3	-150.1	-152.2
51	078	07 30 54	-150.6	-151.0	-152.2	-151.9	-150.7	152.2
52	078	07 44 01	-151.1	-151.7	-153.0	-152.1	-150.4	-153.0
53	078	07 57 07	-151.3	-151.5	-153.1	-152.5	-151.0	-153.1
54	078	08 10 14	-151.5	-151.7	-152.9	-151.9	-151.0	-152.9
55	078	08 23 20	-150.8	-151.2	-152.3	-151.4	-150.2	-152.3
56	078	08 36 27	-151.5	-152.5	-153.5	-152.3	-151.3	-153.[illegible]
57	078	08 49 34	-151.9	-152.1	-153.2	-151.8	-150.5	-153.2
58	078	09 02 40	-150.7	-151.2	-152.3	-151.9	-150.6	-152.3
59	078	09 15 47	-150.7	-151.5	-152.5	-151.2	-150.0	-152.5
60	078	09 28 53	-151.2	-151.5	-152.7	-152.0	-151.2	-152.7
61	078	09 42 00	-151.4	-151.8	-152.6	-151.7	-150.5	-152.6
62	078	09 55 06	-150.0	-150.7	-151.3	-150.7	-149.7	-151.3
63	078	10 08 13	-149.3	-149.6	-150.1	-149.9	-148.9	-150.1
64	078	10 21 19	-149.5	-149.6	-149.8	-148.9	-147.7	-149.8
65	078	10 34 26	-149.2	-149.7	-149.8	-149.3	-148.2	-149.8
66	078	10 47 32	-148.6	-149.0	-149.2	-148.5	-147.7	-149.2
67	078	11 00 39	[illegible]	-148.6	-149.0	-148.4	-147.4	-149.0
68	078	11 13 45	-148.5	-148.4	-149.0	-148.7	-147.6	-149.0
69	078	11 26 52	-148.1	-148.1	-148.1	-147.8	-146.8	-148.1
70	078	11 39 58	-148.6	-148.6	-149.1	-148.6	-147.3	-149.1
71	078	11 57 36	-144.7	-144.8	-145.0	-145.0	-144.7	-145.0
72	078	12 10 43	-148.1	-148.4	-148.4	-148.3	-147.2	-148.4
73	078	12 23 50	-147.7	-148.1	-148.1	-147.7	-146.5	-148.1
74	078	12 36 57	-147.5	-147.5	-147.5	-147.3	-146.7	-147.5
75	078	12 50 03	-147.7	-147.7	-147.8	-147.2	-146.4	-147.8
76	078	13 03 10	-147.0	-147.2	-147.3	-147.2	-146.5	-147.3
77	078	13 16 17	-148.1	-148.2	-148.3	-148.0	-147.3	-148.3
78	078	13 29 24	-147.4	-147.1	-147.0	-146.6	-146.1	-147.4
79	078	13 42 31	-147.3	-147.3	-147.4	-147.1	-146.2	-147.4
80	078	13 55 37	-147.3	-147.6	-147.7	-147.3	-146.4	-147.7
81	078	14 08 44	-147.2	-147.3	-147.3	-146.9	-146.0	-147.3
82	078	14 21 51	-147.8	-147.9	-148.1	-147.8	-147.0	-148.1
83	078	14 34 58	-147.7	-147.6	-147.8	-147.5	-146.8	-147.8
84	078	14 48 05	-146.5	-147.3	-147.3	-147.0	-146.0	-147.3
85	078	15 01 11	-146.8	-146.7	-146.7	-146.7	-146.2	-146.8
86	078	15 14 18	-146.4	-146.6	-146.5	-146.6	-145.4	-146.6
87	078	15 27 25	-146.1	-145.7	-145.9	-145.9	-145.3	-146.1
88	078	15 40 32	-145.7	-145.7	-145.6	-145.5	-144.8	-145.7
89	078	15 53 39	-145.5	-145.7	-145.5	-145.3	-144.7	-145.7
90	078	16 06 45	-146.1	-146.0	-145.9	-145.9	-144.9	-146.1
91	078	16 19 52	-146.5	-146.0	-145.1	-145.8	-145.0	-146.5
92	078	16 32 59	-146.6	-146.9	-146.9	-146.7	-145.4	-146.9
93	078	16 46 06	-147.3	-147.6	-147.8	-147.5	-146.2	-147.8
94	078	16 59 12	-147.0	-147.0	-147.3	-146.9	-146.0	-147.3
95	078	17 12 19	-147.1	-147.4	-147.7	-147.4	-145.9	-147.7
96	078	17 25 26	-147.2	-147.6	-147.9	-147.6	-146.5	-147.9
97	078	17 38 33	-147.9	-147.9	-148.3	-148.3	-147.3	-148.3
98	078	17 51 39	-147.1	-147.4	-147.4	-147.4	-146.7	-147.4
99	078	18 04 46	-147.2	-147.6	-147.8	-147.8	-146.9	-147.8
100	078	18 17 53	-146.6	-147.1	-147.3	-147.6	-146.2	-147.6
101	078	18 31 00	-147.3	-147.3	-147.9	-147.8	-146.7	-147.9
102	078	18 44 06	-147.1	-147.0	-147.4	-147.2	-146.3	-147.4
103	078	18 57 13	-147.1	-147.7	-147.7	-147.4	-146.2	-147.7
104	078	19 10 20	-146.8	-147.1	-147.6	-147.8	-146.5	-147.8
105	078	19 23 26	-147.0	-147.3	-147.5	-147.3	-146.3	-147.5

Table 7 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 77 and 78, 1974

	1		3	4	5	MIN
DAILY MEAN	-148.8	-149.2	-150.1	-149.8	-148.7	-150.2
STANDARD DEV	1.7	1.8	2.3	2.2	2.1	2.3

PROBABILITY DENSITY

-154.0	0	0.0	0	0.0	2	1.9	0	0.0	0	0.0	2	1.9
-153.0	0	0.0	0	0.0	7	6.7	2	1.9	0	0.0	7	6.7
-152.0	2	1.9	6	5.7	23	21.9	12	11.4	2	1.9	23	21.9
-151.0	11	10.5	21	20.0	5	4.8	27	25.7	13	12.4	11	10.5
-150.0	21	20.0	8	7.6	25	23.8	21	20.0	22	21.0	20	19.0
-149.0	5	4.8	23	21.9	5	4.8	2	1.9	23	21.9	4	3.8
-148.0	30	28.6	15	14.3	8	7.6	7	6.7	4	3.8	8	7.6
-147.0	23	21.9	21	20.0	20	19.0	21	20.0	9	8.6	21	20.0
-146.0	10	9.5	6	5.7	5	4.8	7	6.7	23	21.9	6	5.7
-145.0	2	1.9	4	3.8	4	3.8	6	5.7	4	3.8	3	2.9
-144.0	1	1.0	1	1.0	1	1.0	0	0.0	5	4.8	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION

-154.0	0	0.0	0	0.0	2	1.9	0	0.0	0	0.0	2	1.9
-153.0	0	0.0	0	0.0	9	8.6	2	1.9	0	0.0	9	8.6
-152.0	2	1.9	6	5.7	32	30.5	14	13.3	2	1.9	32	30.5
-151.0	13	12.4	27	25.7	37	35.2	41	39.0	15	14.3	43	41.0
-150.0	34	32.4	35	33.3	62	59.0	62	59.0	37	35.2	63	60.0
-149.0	39	37.1	58	55.2	67	63.8	64	61.0	60	57.1	67	63.8
-148.0	69	65.7	73	69.5	75	71.4	71	67.6	64	61.0	75	71.4
-147.0	92	87.6	94	89.5	95	90.5	92	87.6	73	69.5	96	91.4
-146.0	102	97.1	100	95.2	100	95.2	99	94.3	96	91.4	102	97.1
-145.0	104	99.0	104	99.0	104	99.0	105	100.0	100	95.2	105	100.0
-144.0	105	100.0	105	100.0	105	100.0	105	100.0	105	100.0	105	100.0

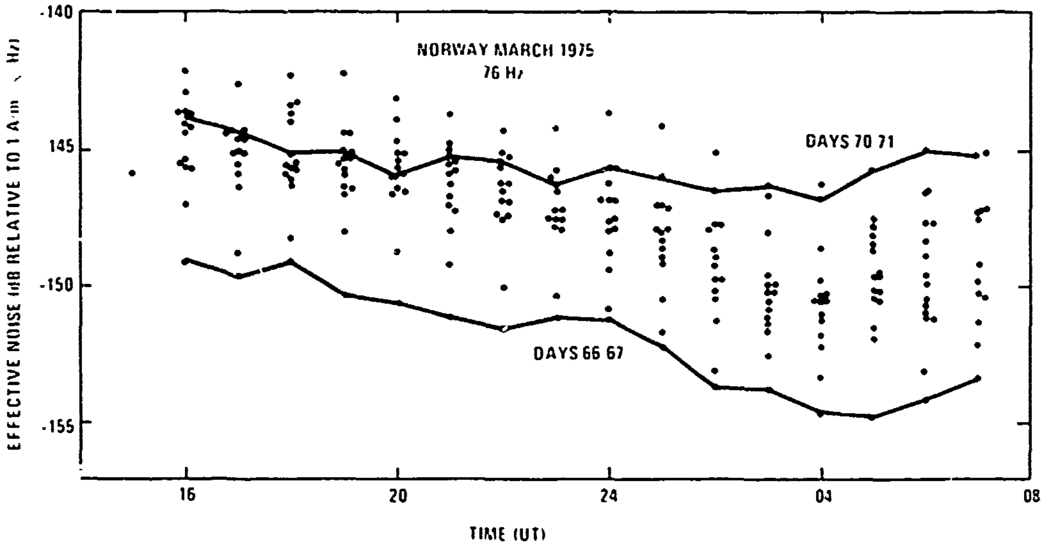

Fig. 5—Hourly samples of minimum effective noise, each averaged over 13 min, for March 1975. The quietest and noisiest days of the month are graphed and designated by Julian day numbers

Table 8 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 85 and 86, 1974 (Noisy Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO 1A/m · $\sqrt{\text{Hz}}$)					
			1	2	3	4	5	MIN.
1	085	20 17 57	-143.4	-143.4	-143.4	$\boxed{-143.7}$	-143.1	-143.7
2	085	20 31.04	-143.3	-143.4	$\boxed{-143.5}$	$\boxed{-143.5}$	-143.0	-143.5
3	085	20 44 10	-142.7	$\boxed{-143.0}$	-142.7	-142.7	-142.2	-143.0
4	085	20 57:17	-142.7	$\boxed{-143.0}$	-142.5	-142.6	-142.2	-143.0
5	085	21 10 23	-142.5	-142.4	-142.3	$\boxed{-142.5}$	-142.1	-142.5
6	085	21:23:30	$\boxed{-143.0}$	-142.8	-142.8	$\boxed{-143.0}$	-142.3	-143.0
7	085	21:36:36	-143.7	$\boxed{-144.0}$	-143.9	-143.8	-143.2	-144.0
8	085	21:49 43	-143.9	-144.4	$\boxed{-144.5}$	-144.4	-143.3	-144.5
9	085	22:02:49	-145.4	-145.7	$\boxed{-145.9}$	-145.7	-144.6	-145.9
10	085	22:15 56	-145.0	$\boxed{-145.4}$	-145.3	-145.3	-144.4	-145.4
11	085	22 29 02	$\boxed{-145.2}$	-144.9	-144.8	-144.8	-144.3	-145.2
12	085	22.42 09	-144.8	-145.0	$\boxed{-145.2}$	-144.9	-144.0	-145.2
13	085	22 55 15	$\boxed{-146.1}$	$\boxed{-146.1}$	$\boxed{-146.1}$	-145.7	-144.8	-146.1
14	085	23 08:22	-146.1	-146.1	$\boxed{-146.3}$	-146.2	-145.7	-146.3
15	085	23 21 28	-146.2	$\boxed{-146.5}$	-146.4	-146.0	-145.1	-146.5
16	085	23 34 35	$\boxed{-146.6}$	-146.1	-146.5	-146.4	-145.6	-146.6
17	085	23 47 41	-146.4	-146.6	$\boxed{-146.7}$	-146.5	-145.4	-146.7
18	086	00 00 48	-146.6	-146.7	$\boxed{-146.8}$	-146.5	-145.7	-146.8
19	086	00 13 54	-146.6	-146.9	$\boxed{-147.1}$	-147.0	-145.9	-147.1
20	086	00 27 01	-147.3	-147.6	$\boxed{-148.0}$	-147.8	-147.1	-148.0
21	086	00 40 07	-147.7	-148.2	$\boxed{-148.4}$	-148.2	-146.8	-148.4
22	086	00.53 14	-147.8	-147.8	$\boxed{-148.2}$	-147.9	-147.1	-148.2
23	086	01 06.20	-148.1	-148.2	$\boxed{-148.7}$	-148.2	-147.1	-148.7
24	086	01.19 26	-147.5	-147.8	-148.1	$\boxed{-148.2}$	-147.1	-148.2
25	086	01 32:33	-148.2	-148.2	$\boxed{-148.3}$	-147.9	-146.9	-148.3
26	086	01.45:39	-148.1	-148.7	$\boxed{-149.2}$	-148.7	-147.3	-149.2
27	086	01.58:46	-148.6	-148.8	$\boxed{-149.4}$	-149.1	-147.7	-149.4
28	086	02:11:52	-149.6	-149.6	$\boxed{-150.0}$	-149.6	-148.8	-150.0
29	086	02:24:59	-149.1	-149.4	$\boxed{-149.7}$	-149.2	-148.5	-149.7
30	086	02:38 05	-149.7	-150.1	$\boxed{-150.4}$	-149.6	-148.5	-150.4
31	086	02.51 12	-149.3	-150.1	$\boxed{-150.7}$	-150.0	-149.2	-150.7
32	086	03 04.18	-149.2	-149.9	$\boxed{-150.4}$	-150.1	-149.2	-150.4
33	086	03:17 25	-149.5	-149.6	$\boxed{-150.2}$	-149.6	-148.5	-150.2
34	086	03:30:31	-149.6	-150.0	$\boxed{-150.6}$	-150.0	-148.6	-150.6
35	086	03.43 37	-150.6	-151.1	$\boxed{-151.4}$	-150.6	-149.5	-151.4
36	086	03.56:44	-150.3	-150.5	$\boxed{-151.1}$	-150.3	-149.1	-151.1
37	086	04 09.50	-149.6	-150.2	$\boxed{-150.4}$	-149.8	-148.6	-150.4
38	086	04.22:57	-148.4	-148.7	$\boxed{-149.1}$	-148.7	-147.7	-149.1
39	086	04.36 03	-149.3	-149.3	$\boxed{-149.4}$	-148.7	-148.0	-149.4
40	086	04.49.10	-148.7	-148.9	$\boxed{-149.0}$	-148.6	-147.8	-149.0
41	086	05.02.16	-148.5	-148.5	$\boxed{-148.6}$	-148.0	-146.8	-148.6
42	086	05.15:23	-148.6	$\boxed{-149.0}$	$\boxed{-149.0}$	-148.5	-147.7	-149.0
43	086	05:28 29	-148.1	-148.6	$\boxed{-148.7}$	-148.2	-147.5	-148.7
44	086	05.41.36	-148.3	$\boxed{-148.5}$	$\boxed{-148.5}$	-148.0	-147.2	-148.5
45	086	05.54.42	-147.5	$\boxed{-147.9}$	-147.8	-147.4	-146.8	-147.9
46	086	06 07.49	-147.5	-147.7	$\boxed{-147.8}$	-147.6	-147.0	-147.8
47	086	06 20 55	-147.3	$\boxed{-147.4}$	$\boxed{-147.4}$	-147.1	-146.3	-147.4
48	086	06 34:02	-147.6	-147.7	$\boxed{-147.9}$	-147.8	-147.2	-147.9
49	086	06 47 08	-146.7	-147.1	$\boxed{-147.2}$	-147.0	-146.2	-147.2
50	086	07 00 15	-147.0	-147.0	$\boxed{-147.1}$	-146.8	-145.9	-147.1
51	086	07 13.21	$\boxed{-147.0}$	-146.9	$\boxed{-147.0}$	-146.6	-145.9	-147.0
52	086	07:26 28	$\boxed{-147.0}$	$\boxed{-147.0}$	-146.7	-146.4	-146.0	-147.0
53	086	07:39.34	-146.9	$\boxed{-147.2}$	-147.1	-146.8	-146.6	-147.2
54	086	07.52:41	-147.0	-146.9	$\boxed{-147.2}$	$\boxed{-147.2}$	-146.7	-147.2
55	086	08.05:47	$\boxed{-147.1}$	$\boxed{-147.1}$	-147.0	-146.6	-146.1	-147.1
56	086	08:18:53	-147.1	-147.3	$\boxed{-147.4}$	-146.8	-145.9	-147.4
57	086	08 32 00	-145.9	$\boxed{-146.4}$	-146.2	-145.6	-145.0	-146.4
58	086	08 45 07	-145.9	$\boxed{-146.2}$	$\boxed{-146.2}$	-145.9	-145.1	-146.2
59	086	08 58:13	-145.7	$\boxed{-145.8}$	$\boxed{-145.8}$	-145.6	-144.7	-145.8
60	086	09 11 20	$\boxed{-146.0}$	-145.8	-145.8	-145.7	-144.8	-146.0
61	086	09.24.26	-146.1	-146.1	$\boxed{-146.3}$	$\boxed{-146.3}$	-145.3	-146.3
62	086	09:37 33	-146.1	$\boxed{-146.6}$	-146.5	-146.3	-144.7	-146.6
63	086	09 50.39	$\boxed{-145.3}$	-145.1	-145.0	-145.1	-144.7	-145.3
64	086	10 03 46	$\boxed{-144.7}$	-144.5	-144.6	-144.3	-143.8	-144.7
65	086	10 16 52	-144.5	$\boxed{-144.6}$	-144.4	-144.2	-143.8	-144.6
66	086	10 29 58	$\boxed{-144.6}$	-144.4	-144.4	-144.3	-143.4	-144.6
67	086	10 42 05	$\boxed{-144.8}$	-144.5	-144.4	-144.4	-143.7	-144.8
68	086	10 55 11	$\boxed{-144.5}$	$\boxed{-144.5}$	$\boxed{-144.5}$	-144.2	-143.3	-144.5
69	086	11 08.18	$\boxed{-144.3}$	$\boxed{-144.3}$	$\boxed{-144.3}$	-144.1	-143.7	-144.3
70	086	11 22 24	$\boxed{-145.2}$	-144.8	-144.9	-144.8	-144.1	-145.2
*71	086	11 40 41	-134.8	-135.8	-136.4	-136.6	-134.2	-136.6
72	086	11 53 48	-145.1	-145.1	$\boxed{-145.2}$	$\boxed{-145.2}$	-144.3	-145.2
73	086	12.06 55	-146.1	-146.1	$\boxed{-146.3}$	$\boxed{-146.3}$	-145.4	-146.3
74	086	12.20 02	-145.4	-145.3	$\boxed{-145.4}$	$\boxed{-145.4}$	-144.5	-145.4
75	086	12.33 08	-144.5	$\boxed{-144.9}$	-144.8	-144.7	-143.8	-144.9
76	086	12 46 15	-144.3	$\boxed{-144.7}$	-144.5	-144.4	-143.8	-144.7
77	086	12.59 22	-144.8	-144.8	$\boxed{-145.0}$	-144.9	-144.4	-145.0
78	086	13:12:29	-144.1	$\boxed{-144.6}$	-144.3	-143.9	-143.4	-144.6
79	086	13.25.36	-143.8	-144.1	-144.1	$\boxed{-144.2}$	-143.3	-144.2
80	086	13 32.43	$\boxed{-145.0}$	-144.9	-144.9	-144.9	-144.3	-145.0
81	086	13 51:50	-143.5	-143.4	-143.4	$\boxed{-143.7}$	-143.2	-143.7
82	086	14 04.57	-143.1	$\boxed{-143.5}$	-143.2	-143.4	-143.1	-143.5
83	086	14 18:04	-143.8	$\boxed{-144.3}$	-144.1	-143.9	-143.4	-144.3
84	086	14:31.10	-144.8	-144.9	-144.9	$\boxed{-145.0}$	-144.2	-145.0
85	086	14.44.17	$\boxed{-144.7}$	$\boxed{-144.7}$	-144.6	$\boxed{-144.7}$	-144.0	-144.7
86	086	14:57:24	-144.9	-145.4	$\boxed{-145.5}$	-145.2	-144.5	-145.5
87	086	15:10:31	-145.3	-145.6	-145.6	$\boxed{-145.9}$	-145.4	-145.9
88	086	15:23 38	-145.8	-145.9	$\boxed{-145.9}$	-145.8	[illegible]	-145.9
89	086	15:36 45	$\boxed{-146.5}$	-146.2	-146.3	-145.8	-145.0	-146.5
90	086	15.49 52	-145.0	$\boxed{-145.3}$	-145.2	-145.1	-144.5	-145.3
91	086	16 02:58	-145.5	$\boxed{-145.7}$	-145.5	-145.3	-144.3	-145.7
92	086	16 16 05	-145.0	$\boxed{-145.6}$	-145.5	-145.5	-144.5	-145.6
93	086	16 29 12	$\boxed{-145.0}$	$\boxed{-145.0}$	$\boxed{-145.0}$	-144.9	-144.2	-145.0
94	086	16:42 19	$\boxed{-145.6}$	-145.4	-145.4	-145.3	-144.1	-145.6
95	086	16:55 26	-145.6	$\boxed{-145.8}$	-145.7	-145.5	-144.7	-145.8
96	086	17 08.33	$\boxed{-146.1}$	-145.8	-146.0	-145.9	-145.8	-146.1
97	086	17:21.40	$\boxed{-146.2}$	-146.0	-145.9	-145.8	-145.7	-146.2
98	086	17.34:46	-146.0	-146.1	$\boxed{-146.2}$	-146.1	-145.1	-146.2
99	086	17:47:53	$\boxed{-146.3}$	-146.0	-146.1	-146.0	-145.1	-146.3
100	086	18.01 00	-145.7	$\boxed{-146.0}$	-145.9	-145.6	-145.0	-146.0
101	086	18 14:07	-146.0	-146.6	$\boxed{-146.7}$	-146.5	-145.3	-146.7
102	086	18.27.14	-145.8	-145.8	-145.9	$\boxed{-146.0}$	-144.9	-146.0

*RECORDING ERROR

Table 9 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 85 and 86, 1974

	1	2	3	4	5	MIN
DAILY MEAN	-146.1	-146.3	-146.3	146.1	-145.3	-146.4
STANDARD DEV	2.2	2.2	2.3	2.1	2.1	2.2

PROBABILITY DENSITY

-151.0	0	0.0	1	1.0	2	2.0	0	0.0	0	0.0	2	2.0
-150.0	2	2.0	5	4.9	7	6.9	3	2.9	0	0.0	7	6.9
-149.0	9	8.8	5	4.9	5	4.9	8	7.8	4	3.9	5	4.9
-148.0	10	9.8	11	10.8	10	9.8	10	9.8	6	5.9	10	9.8
-147.0	10	9.8	12	11.8	11	10.8	9	8.8	13	12.7	12	11.8
-146.0	20	19.6	20	19.6	18	17.6	18	17.6	11	10.8	20	19.6
-145.0	22	21.6	20	19.6	22	21.6	24	23.5	18	17.6	21	20.6
-144.0	16	15.7	18	17.6	17	16.7	18	17.6	28	27.5	15	14.7
-143.0	9	8.8	6	5.9	5	4.9	8	7.8	16	15.7	7	6.9
-142.0	3	2.9	3	2.9	4	3.9	3	2.9	5	4.9	2	2.0
-141.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
-140.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
-139.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
-138.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
-137.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
-136.0	0	0.0	0	0.0	1	1.0	1	1.0	0	0.0	1	1.0
-135.0	0	0.0	1	1.0	0	0.0	0	0.0	0	0.0	0	0.0
-134.0	1	1.0	0	0.0	0	0.0	0	0.0	1	1.0	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION

-151.0	0	0.0	1	1.0	2	2.0	0	0.0	0	0.0	2	2.0
-150.0	2	2.0	6	5.9	9	8.8	3	2.9	0	0.0	9	8.8
-149.0	11	10.8	11	10.8	14	13.7	11	10.8	4	3.9	14	13.7
-148.0	21	20.6	22	21.6	24	23.5	21	20.6	10	9.8	24	23.5
-147.0	31	30.4	34	33.3	35	34.3	30	29.4	23	22.5	36	35.3
-146.0	51	50.0	54	52.9	53	52.0	48	47.1	34	33.3	56	54.9
-145.0	73	71.6	74	72.5	75	73.5	72	70.6	52	51.0	77	75.5
-144.0	89	87.3	92	90.2	92	90.2	90	88.2	80	78.4	92	90.2
-143.0	98	96.1	98	96.1	97	95.1	98	96.1	96	94.1	99	97.1
-142.0	101	99.0	101	99.0	101	99.0	101	99.0	101	99.0	101	99.0
-141.0	101	99.0	101	99.0	101	99.0	101	99.0	101	99.0	101	99.0
-140.0	101	99.0	101	99.0	101	99.0	101	99.0	101	99.0	101	99.0
-139.0	101	99.0	101	99.0	101	99.0	101	99.0	101	99.0	101	99.0
-138.0	101	99.0	101	99.0	101	99.0	101	99.0	101	99.0	101	99.0
-137.0	101	99.0	101	99.0	101	99.0	101	99.0	101	99.0	101	99.0
-136.0	101	99.0	101	99.0	102	100.0	102	100.0	101	99.0	102	100.0
-135.0	101	99.0	102	100.0	102	100.0	102	100.0	101	99.0	102	100.0
-134.0	102	100.0	102	100.0	102	100.0	102	100.0	102	100.0	102	100.0

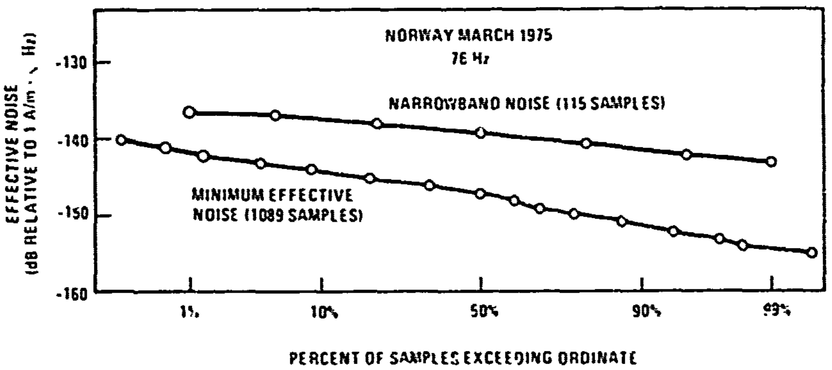

Fig. 6—Cumulative probability distribution of minimum effective noise samples compared with narrowband noise for March 1975

Table 10 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 66 and 67, 1974 (Quiet Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO 1 V/m √Hz) 1	2	3	4	5	MIN
1	067	06 59 00	149.4	150.6	153.1	153.2	152.7	153.1
2	067	06 46 00	153.1	151.8	151.2	153.2	152.1	151.2
3	067	06 33 00	154.1	151.5	151.8	153.7	151.8	154.9
4	067	06 20 00	153.5	154.1	151.5	153.2	151.7	151.5
5	067	06 07 00	153.4	153.8	151.2	153.4	152.4	151.2
6	067	05 54 00	148.5	150.9	151.1	153.9	153.3	154.1
7	067	05 41 00	152.8	153.8	151.6	153.3	152.0	151.6
8	067	05 28 00	151.2	151.2	151.3	152.9	151.8	151.3
9	067	05 15 00	151.0	151.7	155.0	153.5	152.2	155.0
10	067	05 01 00	150.7	152.4	151.7	153.9	152.4	151.7
11	067	04 48 00	151.0	151.7	155.1	153.4	157.1	155.1
12	067	04 35 00	153.8	151.7	155.0	154.2	152.3	155.0
13	067	04 22 00	152.8	153.3	154.8	152.6	151.4	153.8
14	067	04 09 00	153.5	151.7	155.2	151.4	152.0	155.2
15	067	03 56 00	149.6	151.7	151.6	153.7	152.3	151.6
16	067	03 43 00	151.0	151.6	155.1	152.1	152.0	155.1
17	067	03 30 00	153.5	151.7	151.0	152.4	151.2	151.0
18	067	03 17 00	153.3	153.8	151.2	152.5	151.7	151.2
19	067	03 04 00	151.4	153.6	153.7	152.5	152.2	153.7
20	067	02 50 00	149.8	154.8	151.8	154.4	152.8	151.8
21	067	02 37 00	153.3	151.2	151.6	152.8	151.8	151.6
22	067	02 24 00	153.8	153.7	151.0	153.0	152.8	151.0
23	067	02 11 00	153.7	153.8	151.1	153.1	152.5	151.1
24	067	01 58 00	149.2	151.1	153.7	151.3	152.5	153.7
25	067	01 42 00	152.8	153.1	153.7	152.8	152.1	153.7
26	067	01 29 00	152.9	153.3	153.5	152.1	151.2	153.5
27	067	01 15 00	152.9	152.5	152.8	151.7	150.8	152.8
28	067	01 02 00	148.0	149.4	152.0	152.2	151.6	152.2
29	067	00 49 00	144.7	150.2	151.6	150.8	149.8	151.6
30	067	00 36 00	151.0	151.5	151.9	150.8	149.8	151.9
31	067	00 23 00	151.5	151.8	152.1	150.9	149.8	152.1
32	067	00 10 00	152.1	152.6	152.8	151.5	150.8	152.8
33	066	23 57 00	145.7	148.1	151.2	150.8	149.8	151.2
34	066	23 44 00	151.6	151.9	152.2	151.0	149.8	152.2
35	066	23 31 00	150.7	150.8	150.9	150.1	149.9	150.9
36	066	23 18 00	150.2	150.7	150.6	149.1	148.4	150.7
37	066	23 04 00	151.0	151.1	151.1	150.1	149.0	151.1
38	066	22 51 00	145.7	147.6	149.8	150.1	147.1	150.1
39	066	22 38 00	151.2	151.7	152.1	151.2	140.3	152.1
40	066	22 25 00	151.3	151.1	151.5	151.4	150.7	151.5
41	066	22 12 00	150.0	150.2	150.5	150.7	149.9	150.7
42	066	21 59 00	143.7	146.7	149.5	151.5	150.7	151.5
43	066	21 46 00	151.0	150.7	151.1	151.1	150.4	151.1
44	066	21 33 00	150.6	152.5	151.0	151.1	150.3	151.1
45	066	21 20 00	149.8	150.1	150.6	150.3	149.2	150.6
46	066	21 07 00	150.6	150.6	150.8	150.7	149.9	150.8
47	066	20 54 00	144.0	146.7	149.8	151.1	150.4	151.1
48	066	20 40 00	150.3	150.8	151.0	150.8	150.0	151.0
49	066	20 27 00	150.9	151.3	151.6	151.8	150.9	151.8
50	066	20 14 00	149.6	149.9	150.1	150.2	149.7	150.3
51	066	20 01 00	143.6	146.2	149.2	150.6	150.0	150.6
52	066	19 48 00	150.0	150.0	150.1	150.1	149.8	150.1
53	066	19 35 00	149.7	149.7	150.1	150.2	149.5	150.2
54	066	19 22 00	147.8	149.8	150.1	149.9	149.6	150.1
55	066	19 09 00	149.7	149.8	150.1	150.0	149.2	150.1
56	066	18 56 00	143.0	145.7	148.8	150.3	149.8	150.3
57	066	18 43 00	149.2	148.2	149.3	149.6	149.3	149.6
58	066	18 29 00	149.5	149.2	149.5	149.2	149.1	149.5
59	066	18 16 00	143.0	148.9	149.1	149.1	148.8	149.1
60	066	18 03 00	145.8	147.6	149.0	149.1	148.8	149.1
61	066	17 50 00	142.5	144.9	147.9	149.5	148.7	149.5
62	066	17 37 00	149.1	149.3	148.1	148.1	147.4	148.4
63	066	17 24 00	148.5	148.6	148.7	148.6	147.6	148.9
64	066	17 11 00	149.1	149.3	149.3	149.0	148.1	149.2
65	066	16 58 00	142.0	144.4	147.5	147.7	149.1	149.7
66	066	16 45 00	148.2	148.3	148.5	148.1	147.6	148.7
67	066	16 32 00	148.4	148.6	148.7	148.4	147.9	148.7
68	066	16 19 00	148.8	149.1	149.0	148.3	147.3	149.1
69	066	16 05 00	148.6	149.0	149.1	148.6	147.1	149.1
70	066	15 52 00	142.7	144.5	148.1	149.1	148.7	149.1
71	066	15 39 00	149.1	149.2	149.1	149.0	148.2	149.1
72	066	15 26 00	148.0	149.1	149.1	148.9	147.8	149.1

Table 11 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 66 and 67, 1975

	1	2	3	4	5	MIN
DAILY MEAN	150.0	150.8	151.7	151.2	150.3	151.9
STANDARD DEV	3.1	2.7	2.3	1.7	1.6	2.1

PROBABILITY DENSITY

155.0	0	0.0	0	0.0	4	5.6	0	0.0	0	0.0	4	5.6
154.0	4	5.6	9	12.5	16	22.2	1	1.4	0	0.0	16	22.2
153.0	12	16.7	11	15.3	6	8.3	17	23.6	1	1.4	6	8.3
152.0	6	8.3	3	4.2	6	8.3	9	12.5	14	19.4	6	8.3
151.0	7	9.7	10	13.9	8	11.1	9	12.5	12	16.7	11	15.3
150.0	9	12.5	12	16.7	11	15.3	18	25.0	10	13.9	13	18.1
149.0	12	16.7	11	15.3	12	16.7	8	11.1	16	22.2	11	15.3
148.0	11	15.3	7	9.7	7	9.7	10	13.9	12	16.7	5	6.9
147.0	1	1.4	2	2.8	2	2.8	0	0.0	7	9.7	0	0.0
146.0	0	0.0	1	1.4	0	0.0	0	0.0	0	0.0	0	0.0
145.0	3	4.2	3	4.2	0	0.0	0	0.0	0	0.0	0	0.0
144.0	0	0.0	3	4.2	0	0.0	0	0.0	0	0.0	0	0.0
143.0	4	5.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
142.0	2	2.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
141.0	1	1.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION

155.0	0	0.0	0	0.0	4	5.6	0	0.0	0	0.0	4	5.6
154.0	4	5.6	9	12.5	20	27.8	1	1.4	0	0.0	20	27.8
153.0	16	22.2	20	27.8	26	36.1	18	25.0	1	1.4	26	36.1
152.0	22	30.6	23	31.9	32	44.4	27	37.5	15	20.8	32	44.4
151.0	29	40.3	33	45.8	40	55.6	36	50.0	27	37.5	43	59.7
150.0	38	52.8	45	62.5	51	70.8	54	75.0	37	51.4	56	77.8
149.0	50	69.4	56	77.8	63	87.5	62	86.1	53	73.6	67	93.1
148.0	61	84.7	63	87.5	70	97.2	72	100.0	65	90.3	72	100.0
147.0	62	86.1	65	90.3	72	100.0	72	100.0	72	100.0	72	100.0
146.0	62	86.1	66	91.7	72	100.0	72	100.0	72	100.0	72	100.0
145.0	65	90.3	69	95.8	72	100.0	72	100.0	72	100.0	72	100.0
144.0	65	90.3	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
143.0	69	95.8	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
142.0	71	98.6	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
141.0	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0

shows the relative consistency of clipper 3 as the most effective of the processor channels throughout the day with, however, some diversity of performance among the clippers near the bottom of the table. For example, samples 42, 47, 51, 56, 65 and 70 show 1.3 to 2.2 dB of difference in performance between clippers 3 and 4 but only tenths of a decibel difference between clippers 4 and 5, implying that rather large short-term changes in noise conditions took place during this period. Julian days 66 and 67 of 1975 (March 7 and 8) were the beginning of a period of major geophysical disturbance that showed the greatest effect on ELF propagation paths from the Navy test transmitter in Wisconsin to receivers in the northeastern United States, Greenland, and Norway of all of the ELF propagation measurements that have been made to date. The unusually low effective noise indicated in Fig. 5 for this period thus probably resulted from this propagation disturbance affecting atmospheric noise propagation northward from more southerly latitudes. Table 11 contains statistical data for this day indicating that, averaged over the entire day, clippers 3 and 4 both provided good performance.

Table 12 contains sample-by-sample data for the noisy-day case in Fig. 5. The choice among clipper channels varies, as has been shown above to be true in general for relatively noisy conditions. For all samples, however, at least two clipper channels provide nearly equivalent performance, in distinction from the quiet-day case. Thus, even under vigorously disturbed propagation conditions, the choice among clipping levels is less critical for

Table 12 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 70 and 71, 1975 (Noisy Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (dB RELATIVE TO 1 V m^{-1}, $\sqrt{Hz}$)					
			1	2	3	4	5	MIN
1	071	07 04 00	144.7	-144.5	144.3	143.7	-142.9	144.[illegible]
2	071	06 55 00	140.5	-143.6	145.2	144.8	143.8	145.2
3	071	06 42 00	144.6	-144.9	144.6	-143.9	143.0	144.9
4	071	06 28 00	-144.9	-145.0	144.9	143.9	142.3	145.0
5	071	06 15 00	145.4	-145.6	145.4	145.1	144.3	145.6
6	071	06 02 00	140.2	-142.7	144.7	-145.0	144.0	145.8
7	071	05 49 00	144.5	143.6	144.6	-144.2	-143.4	144.6
8	071	05 36 00	145.1	145.[illegible]	145.0	144.5	143.7	145.4
9	071	05 23 00	145.9	-146.2	14[illegible].0	145.5	144.3	146.2
10	071	05 10 00	-144.9	-145.0	-144.8	-144.5	-143.6	145.0
11	071	04 57 00	140.6	-145.3	[illegible]	145.7	144.4	145.7
12	071	04 44 00	-145.4	-145.9	145.6	145.2	143.5	145.9
13	071	04 31 00	-146.2	-145.5	145.7	145.2	143.9	146.2
14	071	04 17 00	-144.6	-146.4	146.6	145.7	143.5	146.8
15	071	04 04 00	144.6	-146.9	146.1	145.6	144.5	146.9
16	071	03 51 00	136.9	139.2	139.3	139.5	136.9	139.5
17	071	03 38 00	-146.5	146.7	146.3	-145.1	143.7	146.7
18	071	03 25 00	146.7	147.3	-147.2	146.2	145.0	147.3
19	071	03 12 00	-144.4	146.7	146.3	145.5	144.1	146.7
20	071	02 59 00	140.9	143.1	145.9	146.3	144.[illegible]	146.3
21	071	02 46 00	146.7	-146.5	146.3	145.7	144.5	146.7
22	071	02 33 00	146.0	146.5	146.1	145.6	144.4	146.5
23	071	02 19 00	145.9	146.5	146.2	145.5	144.5	146.5
24	071	02 06 00	146.1	146.2	-146.2	145.3	144.1	146.1
25	071	01 53 00	140.4	143.3	145.9	146.0	144.9	146.0
26	071	01 40 00	145.9	-145.9	145.6	-144.4	144.0	[illegible]
27	071	01 27 00	145.8	145.8	145.7	145.2	144.2	145.8
28	071	01 14 00	146.6	146.5	146.6	145.9	144.8	146.6
29	071	01 01 00	144.3	143.9	146.0	145.5	144.7	146.0
30	071	00 48 00	146.[illegible]	146.7	-146.1	-145.1	144.1	146.7
31	071	00 35 00	146.1	146.1	146.1	145.2	144.2	146.1
32	071	00 22 00	146.1	145.9	-145.4	-144.9	143.1	146.1
33	071	00 09 00	145.2	145.8	145.3	144.2	143.1	145.8
34	070	23 55 00	140.5	143.1	145.6	145.5	144.1	145.6
35	070	23 42 00	146.0	145.9	145.6	144.7	143.6	146.0
36	070	23 29 00	145.0	145.1	145.0	144.6	143.5	145.1
37	070	23 16 00	146.3	146.2	146.0	145.[illegible]	144.1	146.3
38	070	23 03 00	14[illegible]	144.0	146.2	146.0	145.0	146.2
39	070	22 50 00	14[illegible]	144.[illegible]	146.5	146.4	144.[illegible]	146.5
40	070	22 37 00	146.1	146.1	146.1	145.7	144.5	146.4
41	070	22 24 00	146.2	146.1	146.1	145.7	144.3	146.1
42	070	22 11 00	145.4	14[illegible]	146.0	14[illegible]	144.4	146.0
43	070	21 58 00	139.8	143.3	14[illegible]	145.1	144.5	145.1
44	070	21 44 00	145.7	145.9	145.8	[illegible]	143.4	145.9
45	070	21 31 00	146.1	146.[illegible]	146.2	145.2	144.7	146.[illegible]
46	070	21 18 00	146.[illegible]	146.1	146.2	145.5	144.4	146.5
47	070	21 05 00	14[illegible]	145.1	145.1	145.[illegible]	144.9	145.1
48	070	20 52 00	139.1	-144.5	146.3	146.1	144.4	146.3
49	070	20 39 00	-145.7	145.5	145.1	145.1	144.1	145.7
50	070	20 26 00	145.3	-145.1	145.0	144.6	144.1	145.1
51	070	20 13 00	145.5	145.5	145.2	14[illegible]	143.5	145.5
52	070	19 59 00	140.8	-143.8	145.6	145.8	145.0	145.8
53	070	19 46 00	144.4	145.4	146.0	145.[illegible]	144.1	[illegible]
54	070	19 33 00	145.1	-145.0	144.9	144.1	143.0	145.1
55	070	19 20 00	144.6	144.9	144.8	144.2	143.2	144.9
56	070	19 07 00	144.7	-145.1	144.9	144.5	142.5	145.1
57	070	18 54 00	139.8	142.4	145.0	145.0	143.9	145.0
58	070	18 41 00	145.2	145.2	145.9	144.2	143	-145.3
59	070	18 28 00	145.4	-145.5	145.3	144.6	143.5	145.5
60	070	18 15 00	145.7	145.9	145.6	144.9	143.7	145.9
61	070	18 02 00	129.5	142.3	144.9	145.1	144.8	145.1
62	070	17 49	139.6	136.9	120.7	143.8	14[illegible]	[illegible]
63	070	17 [illegible]	144.1	-144.7	144.0	143.5	143.7	144.7
64	070	17 23 00	144.5	145.2	145.0	144.[illegible]	143.8	145.2
65	070	17 10 00	14[illegible]	-144.4	144.1	143.7	143.4	144.7
66	070	16 56 00	139.6	142.4	144.3	144.3	14[illegible]	144.3
67	070	16 43 00	142.9	144.1	144.1	143.6	14[illegible]	144.1
68	070	16 30 00	143.5	143.[illegible]	143.5	142.9	14[illegible]	14[illegible]
69	070	16 17 00	143.3	143.3	143.7	142.9	142.1	14[illegible]
70	070	16 04 00	143.1	143.6	143.5	142.9	141.9	143.6
71	070	15 51 00	139.2	142.9	143.0	143.6	142.3	[illegible]
72	070	15 38 00	144.9	144.9	144.7	144.7	[illegible]	144.9

Table 13 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 70 and 71, 1975

	1	2	3	4	5	MIN
DAILY MEAN	144.1	144.[illegible]	145.2	144.7	143.4	145.5
STANDARD DEV	2.5	1.[illegible]	1.6	1.6	1.5	1.3

PROBABILITY DENSITY

-147.0	0	0.0	1	1.4	1	1.4	0	0.0	0	0.0	1	1.4
-146.0	19	26.4	17	23.6	22	30.6	4	5.6	0	0.0	26	36.1
-145.0	19	26.4	23	31.9	25	34.7	33	45.8	0	0.0	28	38.9
-144.0	11	15.3	11	15.3	17	23.6	23	31.9	33	45.8	11	15.3
-143.0	4	5.6	11	15.3	5	6.9	7	9.7	26	36.1	4	5.6
-142.0	1	1.4	6	8.3	0	0.0	3	4.2	8	11.1	0	0.0
-141.0	3	4.2	1	1.4	0	0.0	0	0.0	3	4.2	0	0.0
-140.0	8	11.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
-139.0	5	6.9	0	0.0	1	1.4	1	1.4	0	0.0	1	1.4
-138.0	1	1.4	1	1.4	0	0.0	0	0.0	1	1.4	1	1.4
-137.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
-136.0	1	1.4	1	1.4	0	0.0	0	0.0	0	0.0	0	0.0
-135.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
-134.0	0	0.0	0	0.0	1	1.4	0	0.0	1	1.4	0	0.0
-133.0	0	0.0	0	0.0	0	0.0	1	1.4	0	0.0	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION

-147.0	0	0.0	1	1.4	1	1.4	0	0.0	0	0.0	1	1.4
-146.0	19	26.4	18	25.0	23	31.9	4	5.6	0	0.0	27	37.5
-145.0	38	52.8	41	56.9	48	66.7	37	51.4	0	0.0	55	76.4
-144.0	49	68.1	52	72.2	65	90.3	60	83.3	33	45.8	66	91.7
-143.0	53	73.6	63	87.5	70	97.2	67	93.1	59	81.9	70	97.2
-142.0	54	75.0	69	95.8	70	97.2	70	97.2	67	93.1	70	97.2
-141.0	57	79.2	70	97.2	70	97.2	70	97.2	70	97.2	70	97.2
-140.0	65	90.3	70	97.2	70	97.2	70	97.2	70	97.2	70	97.2
-139.0	70	97.2	70	97.2	71	98.6	71	98.6	70	97.2	71	98.6
-138.0	71	98.6	71	98.6	71	98.6	71	98.6	71	98.6	72	100.0
-137.0	71	98.6	71	98.6	71	98.6	71	98.6	71	98.6	72	100.0
-136.0	72	100.0	72	100.0	71	98.6	71	98.6	71	98.6	72	100.0
-135.0	72	100.0	72	100.0	71	98.6	71	98.6	71	98.6	72	100.0
-134.0	72	100.0	72	100.0	72	100.0	71	98.6	72	100.0	72	100.0
-133.0	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0

relatively noisy conditions than for quiet conditions. Table 13 bears out this indication. Table 14 contains the statistics of all 1089 samples acquired during March 1975. Figure 6 contains the comparison of cumulative probability distributions between minimum effective noise and the narrowband noise data that were recorded simultaneously. Both graphs are virtually indistinguishable from those of Fig. 4, indicating seasonal consistency of the noise from year to year.

Figures 7-8 and Tables 15-19 contain summer data from July and August 1975. The indication of diurnal variation is less distinct than for the winter data, as might be expected both from the circumstance that the overhead ionosphere is continuously sunlit in summer at Tromsø and because thunderstorms in the area become important noise sources. Figure 7 shows what may indicate a diurnal trend of minimum noise in the early morning and maximum noise in late afternoon and evening. There seems to be on intraday minimum near 17 UT.

Table 14 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, March 1975

PROBABILITY DENSITY

	1		2		3		4		5		MIN	
155.0	0	.0	0	.0	4	.4	0	.0	0	.0	4	.4
154.0	4	.4	9	.8	16	1.5	1	.1	0	.0	16	1.5
153.0	16	1.5	11	1.0	11	1.0	17	1.6	1	.1	12	1.1
152.0	28	2.6	23	2.1	34	3.1	16	1.5	14	1.3	36	3.3
151.0	44	4.0	52	4.8	69	6.3	51	4.7	14	1.3	74	6.8
150.0	87	8.0	76	7.0	99	9.1	91	8.4	40	3.7	105	9.6
149.0	98	9.0	95	8.7	100	9.2	105	9.6	83	7.6	100	9.2
148.0	92	8.4	87	8.0	79	7.3	107	9.8	110	10.1	85	7.8
147.0	83	7.6	108	9.9	96	8.8	94	8.6	107	9.8	112	10.3
146.0	144	13.2	143	13.1	149	13.7	136	12.5	110	10.1	171	15.7
145.0	139	12.8	137	12.6	145	13.3	191	17.5	153	14.0	169	15.5
144.0	106	9.7	112	10.3	136	12.5	154	14.1	194	17.8	109	10.0
143.0	79	7.3	80	7.3	79	7.3	70	6.4	161	14.8	54	5.0
142.0	57	5.2	55	5.1	43	3.9	40	3.7	66	6.1	28	2.6
141.0	30	2.8	46	4.2	17	1.6	10	.9	28	2.6	8	.7
140.0	43	3.9	28	2.6	9	.8	4	.4	4	.4	4	.4
139.0	30	2.8	17	1.6	2	.2	1	.1	2	.2	1	.1
138.0	2	.2	1	.1	0	.0	0	.0	1	.1	1	.1
137.0	6	.6	3	.3	0	.0	0	.0	0	.0	0	.0
136.0	1	.1	1	.1	0	.0	0	.0	0	.0	0	.0
135.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
134.0	0	.0	0	.0	1	.1	0	.0	1	.1	0	.0
133.0	0	.0	0	.0	0	.0	1	.1	0	.0	0	.0

CUMULATIVE PROBABILITY DISTRIBUTION

	1		2		3		4		5		MIN	
155.0	0	.0	0	.0	4	.4	0	.0	0	.0	4	.4
154.0	4	.4	9	.8	20	1.8	1	.1	0	.0	20	1.8
153.0	20	1.8	20	1.8	31	2.8	18	1.7	1	.1	32	2.9
152.0	48	4.4	43	3.9	65	6.0	34	3.1	15	1.4	68	6.2
151.0	92	8.4	95	8.7	134	12.3	85	7.8	29	2.7	142	13.0
150.0	179	16.4	171	15.7	233	21.4	176	16.2	69	6.3	247	22.7
149.0	277	25.4	266	24.4	333	30.6	281	25.8	152	14.0	347	31.9
148.0	369	33.9	353	32.4	412	37.8	388	35.6	262	24.1	432	39.7
147.0	452	41.5	461	42.3	508	46.6	482	44.3	369	33.9	544	50.0
146.0	596	54.7	604	55.5	657	60.3	618	56.7	479	44.0	715	65.7
145.0	735	67.5	741	68.0	802	73.6	809	74.3	632	58.0	884	81.2
144.0	841	77.2	853	78.3	938	86.1	963	88.4	826	75.8	993	91.2
143.0	920	84.5	935	85.9	1017	93.4	1033	94.9	987	90.6	1047	96.1
142.0	977	89.7	990	90.9	1060	97.3	1073	98.5	1053	96.7	1075	98.7
141.0	1007	92.5	1036	95.1	1077	98.9	1083	99.4	1081	99.3	1083	99.4
140.0	1050	96.4	1064	97.7	1086	99.7	1087	99.8	1085	99.6	1087	99.8
139.0	1080	99.2	1081	99.3	1088	99.9	1088	99.9	1087	99.8	1088	99.9
138.0	1082	99.4	1082	99.4	1088	99.9	1088	99.9	1088	99.9	1089	100.0
137.0	1088	99.9	1085	99.6	1088	99.9	1088	99.9	1088	99.9	1089	100.0
136.0	1089	100.0	1089	100.0	1088	99.9	1088	99.9	1088	99.9	1089	100.0
135.0	1089	100.0	1089	100.0	1088	99.9	1088	99.9	1088	99.9	1089	100.0
134.0	1089	100.0	1089	100.0	1089	100.0	1088	99.9	1089	100.0	1089	100.0
133.0	1089	100.0	1089	100.0	1089	100.0	1089	100.0	1089	100.0	1089	100.0

The large disparity between the noisiest and quietest days in Fig. 7 may be attributable to the fact that the two-week period in which they fell was a period of substantial geophysical disturbance, with several magnetic storms and considerable variability in ELF propagation conditions. Conceivably, the apparent diurnal noise minimum near 17 UT in Fig. 7 could be an artifact of the geophysical disturbance that affected the ionosphere during most of the data collection period.

Table 15 shows sample-by-sample data from the quiet-day case (day 226), with one clipper channel as the consistent best or near-best choice for the entire day, as expected. Table 16 confirms this circumstance and indicates once more that for relatively quiet conditions, there can be substantial differences in performance among clipper channels. Table 17 shows the noisy-day sample-by-sample data, with far more variance in channel choice than on the quiet day, but also much less of a performance differential among channels. Table 18 reflects this relative uniformity of performance, showing only 0.4 dB of difference in daily mean effective noise level among four clipper channels. Table 19

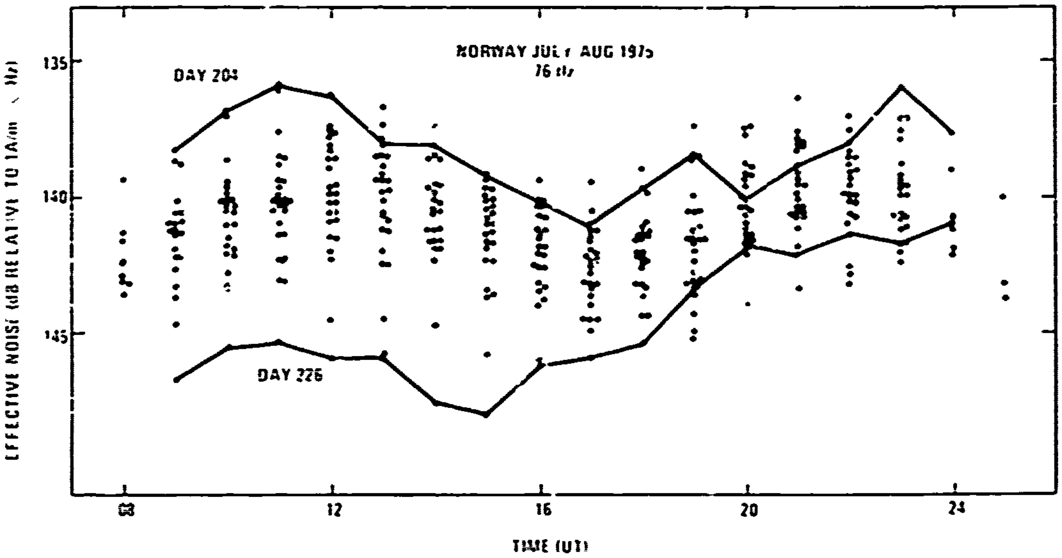

Fig. 7—Hourly samples of minimum effective noise, each averaged over 13 min, for July and August 1975. The quietest and noisest days of the month are graphed and designated by Julian day numbers

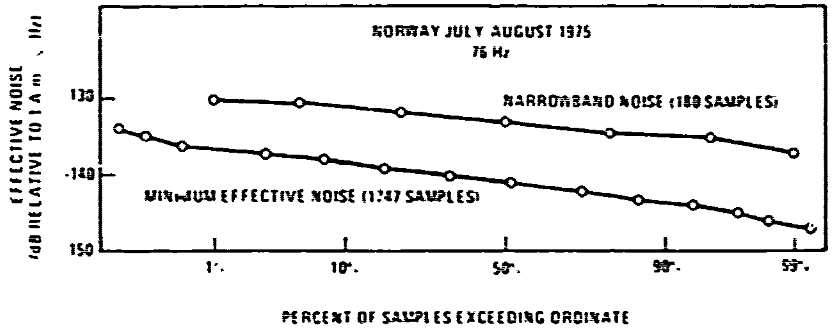

Fig. 8—Cumulative probability distribution of minimum effective noise samples compared with narrowband noise for July and August 1975

Table 15 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Day 226, 1975 (Quiet Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO [illegible])					
			1	2	3	4	5	[illegible]
1	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
28	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
29	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
31	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
32	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
33	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
34	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
36	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
37	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
38	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
39	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
40	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
41	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
42	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
43	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
44	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
45	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
46	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
47	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
48	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
49	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
50	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
51	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
52	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
53	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
54	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
55	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
56	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
57	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
58	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
59	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
60	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
61	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
62	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
63	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
64	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
65	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
66	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
67	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
68	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
69	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
70	226	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 16 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, Julian Day 226, 1975

	1	2	3	4	5	MIN
DAILY MEAN	-114.2	-114.8	-114.1	-112.9	-112.1	-114.8
STANDARD DEV	1.9	2.3	1.9	1.6	1.5	2.2

PROBABILITY DENSITY

-118.0	0	0.0	3	4.3	0	0.0	0	0.0	0	0.0	3	4.3
-117.0	0	0.0	9	12.9	0	0.0	0	0.0	0	0.0	9	12.9
-116.0	10	14.3	15	21.4	11	15.7	0	0.0	0	0.0	15	21.4
-115.0	27	38.6	16	22.9	22	31.4	4	5.7	0	0.0	16	22.9
-114.0	9	12.9	2	2.9	11	15.7	19	27.1	6	8.6	3	4.3
-113.0	3	4.3	4	5.7	3	4.3	19	27.1	15	21.4	4	5.7
-112.0	5	7.1	5	7.1	6	8.6	5	7.1	23	32.9	5	7.1
-111.0	13	18.6	11	15.7	13	18.6	10	14.3	5	7.1	14	20.0
-110.0	3	4.3	5	7.1	4	5.7	11	15.7	13	18.6	1	1.4
-109.0	0	0.0	0	0.0	0	0.0	2	2.9	7	10.0	0	0.0
-108.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.4	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION

-118.0	0	0.0	3	4.3	0	0.0	0	0.0	0	0.0	3	4.3
-117.0	0	0.0	12	17.1	0	0.0	0	0.0	0	0.0	12	17.1
-116.0	10	14.3	27	38.6	11	15.7	0	0.0	0	0.0	27	38.6
-115.0	37	52.9	43	61.4	33	47.1	4	5.7	0	0.0	43	61.4
-114.0	46	65.7	45	64.3	44	62.9	23	32.9	6	8.6	46	65.7
-113.0	49	70.0	49	70.0	47	67.1	42	60.0	21	30.0	50	71.4
-112.0	54	77.1	54	77.1	53	75.7	47	67.1	44	62.9	55	78.6
-111.0	67	95.7	65	92.9	66	94.3	57	81.4	49	70.0	69	98.6
-110.0	70	100.0	70	100.0	70	100.0	68	97.1	62	88.6	70	100.0
-109.0	70	100.0	70	100.0	70	100.0	70	100.0	69	98.6	70	100.0
-108.0	70	100.0	70	100.0	70	100.0	70	100.0	70	100.0	70	100.0

contains the monthly statistical data for the five clipper channels and for the minimum effective noise channel for each sample. Figure 8 illustrates the nearly log-normal characteristic of summer nonlinear processed data, with a hint of a tail at amplitudes above the 1% exceedence level, indicating some residual spikiness in the data.

Comparison of narrowband with wideband noise data, if taken at face value in Fig. 8, suggests that nonlinear processing is less advantageous for high-noise data than for the winter and spring (low-noise) data. However, as explained above, under summer conditions the narrowband recording system imposes an unspecified degree of preclipping on the data and causes an under-estimate of the noise level. Nonlinear processing thus achieves at least the 8 dB of advantage in S/N indicated by Fig. 8 and probably exceeds that advantage considerably.

Figures 9-10 and Tables 20-24 contain data from October and November 1975. Diurnal variation and mean effective noise levels similar to those of the winter data are evident in Fig. 9. (Relative to the winter solstice, these fall data would correspond to a period between the January and March data.) The extent of the diurnal variation is 5 to 7 dB, in agreement with the January 1974 examples. The quiet-day and noisy-day extremes in Fig. 9 are significantly separated, particularly in the morning hours that were shown in the midwinter data of January 1974 to be substantially separated as

Table 17 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Day 204, 1975 (Noisy Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO 1A/m/$\sqrt{Hz}$)					
			1	2	3	4	5	MIN
1	204	08 38 21	-138.2	-138.5	-138.6	-137.9	-137.6	-138.6
2	204	08 51 31	-138.1	-138.4	-138.5	-138.0	-137.4	-138.5
3	204	09 04 38	-137.8	-138.3	-138.2	-137.7	-136.9	-138.3
4	204	09 17 45	-137.4	-137.3	-137.6	-137.1	-136.7	-137.6
5	204	09 30 52	-138.0	-138.3	-138.5	-137.9	-137.4	-138.5
6	204	09 43 59	-137.7	-137.5	-137.3	-137.2	-137.0	-137.7
7	204	09 57 07	-136.6	-136.6	-136.8	-136.4	-136.2	-136.8
8	204	10 10 14	-137.6	-137.5	-137.5	-137.4	-137.4	-137.6
9	204	10 23 21	-136.4	-136.4	-136.0	-135.6	-135.5	-136.4
10	204	10 36 28	-136.3	-136.4	-136.3	-136.1	-135.6	-136.4
11	204	10 49 35	-136.1	-136.7	-136.5	-136.1	-135.9	-136.7
12	204	11 02 42	-135.9	-135.4	-135.5	-135.2	-135.3	-135.9
13	204	11 15 49	-137.4	-136.7	-137.1	-136.6	-136.7	-137.4
14	204	11 28 56	-136.0	-136.0	-136.3	-136.1	-135.6	-136.3
15	204	11 42 03	-135.7	-135.6	-135.4	-135.1	-135.0	-135.7
16	204	11 55 11	-136.0	-136.2	-136.3	-136.0	-135.6	-136.3
17	204	12 08 18	-136.4	-136.3	-136.4	-136.1	-135.8	-136.4
18	204	12 21 25	-136.0	-136.2	-136.0	-135.8	-135.9	-136.2
19	204	12 34 32	-136.5	-136.8	-136.7	-136.7	-135.7	-136.8
20	204	12 47 39	-137.6	-137.5	-137.0	-136.8	-137.1	-137.6
21	204	13 00 46	-138.0	-137.1	-137.1	-136.8	-136.5	-138.0
22	204	13 13 53	-136.8	-137.4	-137.2	-136.9	-136.4	-137.4
23	204	13 27 00	-137.3	-137.6	-137.7	-137.2	-136.9	-137.7
24	204	13 40 07	-137.6	-138.1	-137.7	-137.4	-136.8	-138.1
25	204	13 53 14	-138.4	-138.9	-138.7	-138.4	-137.5	-138.9
26	204	14 06 21	-138.0	-138.1	-138.0	-137.1	-137.1	-138.1
27	204	14 19 28	-138.2	-138.2	-138.0	-137.6	-137.0	-138.2
28	204	14 32 35	-138.9	-138.9	-138.7	-138.4	-138.1	-138.9
29	204	14 45 42	-139.0	-138.9	-139.3	-138.6	-137.6	-139.3
30	204	14 58 49	-139.0	-139.0	-139.2	-138.5	-137.7	-139.2
31	204	15 11 57	-139.4	-139.9	-139.9	-138.9	-138.5	-139.9
32	204	15 25 04	-138.7	-138.6	-139.0	-138.5	-137.8	-139.0
33	204	15 38 11	-139.6	-139.5	-139.8	-138.7	-137.9	-139.8
34	204	15 51 18	-140.2	-140.1	-139.9	-139.2	-139.0	-140.2
35	204	16 04 25	-139.9	-140.1	-140.1	-139.5	-139.1	-140.1
36	204	16 17 32	-139.5	-139.1	-138.9	-138.0	-137.3	-139.5
37	204	16 30 39	-140.5	-140.1	-140.4	-139.7	-138.6	-140.5
38	204	16 43 46	-139.7	-139.8	-139.8	-139.2	-138.3	-139.8
39	204	16 56 53	-141.3	-141.0	-141.0	-140.2	-139.8	-141.3
40	204	17 10 00	-141.2	-141.0	-140.8	-139.7	-139.3	-141.2
41	204	17 23 07	-140.5	-140.6	-140.6	-139.8	-138.8	-140.6
42	204	17 36 14	-140.6	-140.9	-140.4	-140.1	-139.4	-140.9
43	204	17 49 21	-140.2	-140.6	-140.3	-139.9	-139.4	-140.6
44	204	18 02 28	-139.9	-139.3	-139.1	-139.0	-138.5	-139.9
45	204	18 15 35	-140.2	-140.0	-139.8	-139.5	-139.0	-140.2
46	204	18 28 42	-139.3	-139.2	-139.3	-138.8	-138.1	-139.3
47	204	18 41 49	-139.1	-139.3	-139.4	-138.8	-138.5	-139.4
48	204	18 54 56	-138.2	-138.5	-138.5	-138.1	-138.0	-138.5
49	204	19 08 03	-138.8	-138.8	-138.6	-137.6	-137.3	-138.8
50	204	19 21 10	-139.2	-139.6	-139.9	-139.5	-139.1	-139.9
51	204	19 34 17	-139.5	-139.4	-139.1	-138.5	-138.1	-139.5
52	204	19 47 24	-138.7	-138.6	-139.0	-138.5	-138.0	-139.0
53	204	20 00 31	-138.9	-139.2	-138.9	-138.5	-138.0	-139.2
54	204	20 13 38	-138.5	-138.4	-138.9	-138.3	-137.7	-138.9
55	204	20 26 45	-139.0	-139.2	-139.0	-138.7	-138.1	-139.2
56	204	20 39 52	-138.3	-138.2	-138.3	-138.1	-137.8	-138.3
57	204	20 52 59	-138.9	-138.4	-138.4	-138.1	-138.3	-138.9
58	204	21 06 06	-138.4	-138.9	-138.7	-138.5	-138.3	-138.9
59	204	21 19 12	-137.1	-137.8	-137.5	-137.1	-136.9	-137.8
60	204	21 32 19	-138.3	-137.9	-138.2	-138.1	-137.6	-138.3
61	204	21 45 26	-137.0	-137.3	-137.3	-136.9	-137.0	-137.3
62	204	21 58 33	-137.4	-137.7	-138.1	-137.5	-137.1	-138.1
63	204	22 11 40	-137.4	-137.2	-137.6	-137.7	-137.6	-137.7
64	204	22 24 47	-136.2	-136.9	-136.6	-136.3	-136.7	-136.9
65	204	22 37 54	-136.6	-136.2	-136.7	-136.7	-135.4	-136.7
66	204	22 51 01	-136.9	-136.7	-136.9	-137.0	-136.7	-137.0
67	204	23 04 08	-135.7	-135.9	-136.0	-135.4	-135.3	-136.0
68	204	23 17 15	-136.1	-135.9	-136.0	-136.2	-135.8	-136.2
69	204	23 30 22	-136.3	-136.4	-136.3	-136.2	-136.2	-136.4
70	204	23 43 29	-136.3	-136.6	-136.9	-136.5	-136.3	-136.9
71	204	23 56 36	-137.7	-137.7	-137.6	-137.2	-137.0	-137.7

Table 18 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, Julian Day 204, 1975

	1	2	3	4	5	MIN
DAILY MEAN	-138.1	-138.1	[illegible]	-137.7	-137.3	-138.3
STANDARD DEV	[illegible]	[illegible]	1.4	1.3	1.1	1.4

PROBABILITY DENSITY

-141.0	2	2.8	1	1.4	0	0.0	0	0.0	0	0.0	2	2.8
-140.0	6	8.5	8	11.3	7	9.9	2	2.8	0	0.0	7	9.9
-139.0	10	14.1	12	16.9	13	18.3	9	12.7	7	9.9	13	18.3
-138.0	18	25.4	18	25.4	19	26.8	21	29.6	13	18.3	19	26.8
-137.0	16	22.5	13	18.3	14	19.7	16	22.5	23	32.4	12	16.9
-136.0	15	21.1	14	19.7	15	21.1	17	23.9	16	22.5	16	22.5
-135.0	4	5.6	5	7.0	3	4.2	6	8.5	11	15.5	2	2.8
-134.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.4	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION

-141.0	2	2.8	1	1.4	0	0.0	0	0.0	0	0.0	2	2.8
-140.0	8	11.3	9	12.7	7	9.9	2	2.8	0	0.0	9	12.7
-139.0	18	25.4	21	29.6	20	28.2	11	15.5	7	9.9	22	31.0
-138.0	36	50.7	39	54.9	39	54.9	32	45.1	20	28.2	41	57.7
-137.0	52	73.2	52	73.2	53	74.6	48	67.6	43	60.6	53	74.6
-136.0	67	94.4	66	93.0	68	95.8	65	91.5	59	83.1	69	97.2
-135.0	71	100.0	71	100.0	71	100.0	71	100.0	70	98.6	71	100.0
-134.0	71	100.0	71	100.0	71	100.0	71	100.0	71	100.0	71	100.0

well. Table 20 contains the quiet-day sample-by-sample data, with little variation in best clipper choice during the later, quieter period of the data and several examples of substantial performance differences among channels. Table 21 contains statistical information for the quiet-day data.

Table 22 lists the noisy-day samples, shows their wider diversity of best clipping levels, and confirms the uniformity of clipper performance under these conditions. The statistical listings in Table 23 confirm these findings.

Table 24 contains the statistical accounting for the full month's data (a probability density is unavailable due to a computer error), and Fig. 10 compares minimum effective noise and narrowband noise cumulative probability distributions. Both graphs fall almost precisely between those for the January and March data, respectively.

CONCLUSIONS

Data presented in this report are from one-month collections of auroral zone ELF noise during each of the seasons of the year. They represent a reasonably comprehensive sampling of noise and propagation conditions, from stable to highly disturbed, and extend over nearly all hours of the day in each season. Lowest-noise fractions of the day have been left out of the summer and fall data, however.

Several important conclusions can be drawn:

Table 19 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, July and August 1975

PROBABILITY DENSITY

	1		2		3		4		5		MIN	
-148.0	0	0.0	3	0.2	0	0.0	0	0.0	0	0.0	3	0.2
-147.0	0	0.0	9	0.5	0	0.0	0	0.0	0	0.0	9	0.5
-146.0	10	0.6	17	1.0	11	0.6	0	0.0	0	0.0	17	1.0
-145.0	35	2.0	25	1.4	28	1.6	4	0.2	0	0.0	25	1.4
-144.0	56	3.2	58	3.3	53	3.0	19	1.1	6	0.3	61	3.5
-143.0	118	6.7	129	7.4	126	7.2	51	2.9	16	0.9	140	8.0
-142.0	200	11.4	204	11.7	199	11.4	146	8.3	68	3.9	217	12.4
-141.0	353	20.2	326	18.6	329	18.8	243	13.9	188	10.7	347	19.8
-140.0	325	18.6	354	20.2	366	20.9	388	22.2	286	16.4	353	20.2
-139.0	301	17.2	300	17.2	300	17.2	394	22.5	455	26.0	274	15.7
-138.0	191	10.9	167	9.5	181	10.3	280	16.0	387	22.1	170	9.7
-137.0	100	5.7	100	5.7	100	5.7	140	8.0	215	12.3	86	4.9
-136.0	44	2.5	43	2.5	42	2.4	64	3.7	92	5.3	40	2.3
-135.0	11	0.6	9	0.5	10	0.6	16	0.9	30	1.7	3	0.2
-134.0	2	0.1	3	0.2	0	0.0	0	0.0	2	0.1	2	0.1
-133.0	1	0.1	0	0.0	0	0.0	1	0.1	1	0.1	0	0.0
-132.0	0	0.0	0	0.0	2	0.1	0	0.0	1	0.1	0	0.0
-131.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
-130.0	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0
-129.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
-128.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
-127.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1	1	0.1
-126.0	0	0.0	0	0.0	0	0.0	1	0.1	1	0.1	1	0.1
-125.0	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0
-124.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
-123.0	0	0.0	1	0.1	1	0.1	0	0.0	0	0.0	0	0.0
-122.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
-121.0	1	0.1	0	0.0	1	0.1	1	0.1	0	0.0	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION

	1		2		3		4		5		MIN	
-148.0	0	0.0	3	0.2	0	0.0	0	0.0	0	0.0	3	0.2
-147.0	0	0.0	12	0.7	0	0.0	0	0.0	0	0.0	12	0.7
-146.0	10	0.6	29	1.7	11	0.6	0	0.0	0	0.0	29	1.7
-145.0	45	2.6	54	3.1	39	2.2	4	0.2	0	0.0	54	3.1
-144.0	101	5.8	112	6.4	92	5.3	23	1.3	6	0.3	115	6.6
-143.0	219	12.5	241	13.8	218	12.5	74	4.2	22	1.3	255	14.6
-142.0	419	24.0	445	25.4	417	23.8	220	12.6	90	5.1	472	27.0
-141.0	772	44.1	771	44.1	746	42.7	463	26.5	278	15.9	819	46.8
-140.0	1097	62.7	1125	64.3	1112	63.6	851	48.7	564	32.2	1172	67.0
-139.0	1398	79.9	1425	81.5	1412	80.7	1245	71.2	1019	58.3	1446	82.7
-138.0	1589	90.9	1592	91.0	1593	91.1	1525	87.2	1406	80.4	1616	92.4
-137.0	1689	96.6	1692	96.7	1693	96.8	1665	95.2	1621	92.7	1702	97.3
-136.0	1733	99.1	1735	99.2	1735	99.2	1729	98.9	1713	97.9	1742	99.6
-135.0	1744	99.7	1744	99.7	1745	99.8	1745	99.8	1743	99.7	1745	99.8
-134.0	1746	99.8	1747	99.9	1745	99.8	1745	99.8	1745	99.8	1747	99.9
-133.0	1747	99.9	1747	99.9	1745	99.8	1746	99.8	1746	99.8	1747	99.9
-132.0	1747	99.9	1747	99.9	1747	99.9	1746	99.8	1747	99.9	1747	99.9
-131.0	1747	99.9	1747	99.9	1747	99.9	1746	99.8	1747	99.9	1747	99.9
-130.0	1747	99.9	1747	99.9	1747	99.9	1747	99.9	1747	99.9	1747	99.9
-129.0	1747	99.9	1747	99.9	1747	99.9	1747	99.9	1747	99.9	1747	99.9
-128.0	1747	99.9	1747	99.9	1747	99.9	1747	99.9	1747	99.9	1747	99.9
-127.0	1747	99.9	1747	99.9	1747	99.9	1747	99.9	1748	99.9	1748	99.9
-126.0	1747	99.9	1747	99.9	1747	99.9	1748	99.9	1749	100.0	1749	100.0
-125.0	1747	99.9	1748	99.9	1747	99.9	1748	99.9	1749	100.0	1749	100.0
-124.0	1747	99.9	1748	99.9	1747	99.9	1748	99.9	1749	100.0	1749	100.0
-123.0	1747	99.9	1749	100.0	1748	99.9	1748	99.9	1749	100.0	1749	100.0
-122.0	1748	99.9	1749	100.0	1748	99.9	1748	99.9	1749	100.0	1749	100.0
-121.0	1749	100.0	1749	100.0	1749	100.0	1749	100.0	1749	100.0	1749	100.0

- The typical monthly variation in minimum effective noise, between the noisiest and quietest days, is greatest in the 06-10 UT interval near the winter solstice, when the sunrise terminator approaches the receiving site with the steepest south-north trajectory. This confirms the expectation of greater variability of propagation conditions for noise propagating from the south during these rapid ionospheric changes than in other seasons. It may be concluded that the greatest variability in received S/N may be expected at receiver site midmorning.

- Under relatively quiet conditions, there is a gradual, regular, diurnal change of best clip level over a span of approximately 12 dB, but there is seldom more than a few tenths of a decibel difference in performance between clipper channels in this interval. Occasionally clipper channels separated by 6 dB yield as much as 2 dB of difference in performance, but these occasions are infrequent and of short duration.

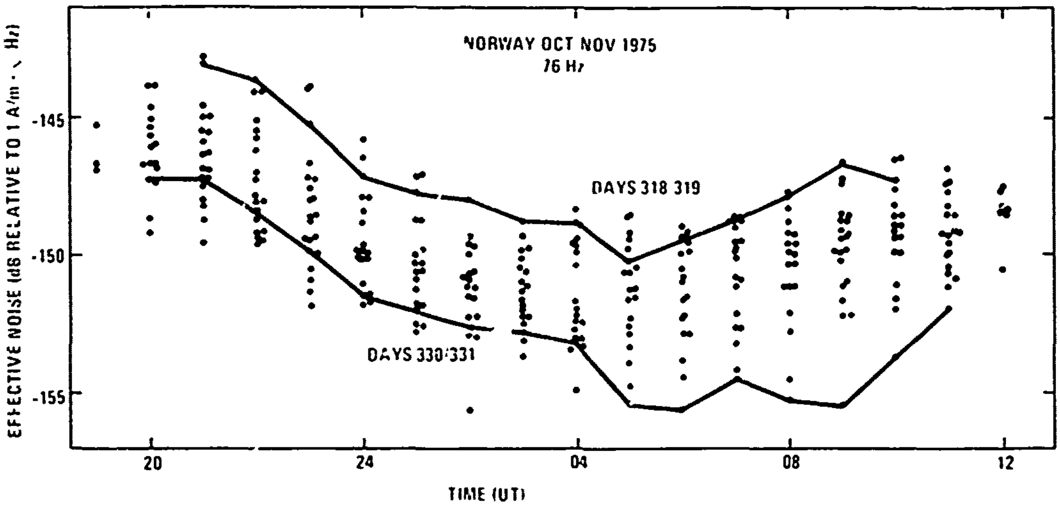

Fig. 9—Hourly samples of minimum effective noise, each averaged over 13 min, for October and November 1975. The quietest and noisiest days of the month are graphed and designated by Julian day numbers

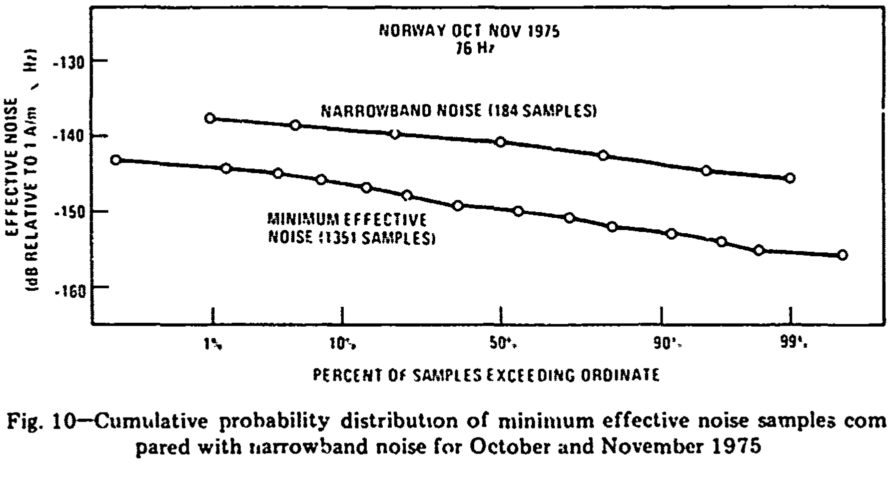

Fig. 10—Cumulative probability distribution of minimum effective noise samples compared with narrowband noise for October and November 1975

Table 20 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 330 and 331, 1975 (Quiet Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO $1A\,m^{-1}/\sqrt{Hz}$)					
			1	2	3	4	5	MIN
1	330		-146.7	-146.9	-146.9	-146.2	-144.8	-146.9
2	330		-146.7	-146.7	-146.5	146.1	-144.9	-146.7
3	330		-147.2	-146.9	146.9	-146.2	-144.8	-147.2
4	330		-147.4	-147.6	-147.5	-146.8	-145.5	-147.6
5	330		-147.7	-147.8	-147.7	-147.2	-146.1	-147.8
6	330		-148.2	-148.2	-148.3	-147.7	-146.0	-148.3
7	330		-147.8	-148.0	-148.0	-147.2	-146.2	-148.0
8	330		147.2	-147.2	-147.0	-146.2	-145.	-147.2
9	330		-147.1	-147.1	-146.8	-146.1	-145	-147.1
10	330		-147.6	-147.7	-147.6	-146.6	-145.3	-147.7
11	330		-147.7	-147.8	-147.7	-146.8	-145.5	-147.8
12	330		-148.4	-148.3	-148.3	-147.3	-146.4	-148.4
13	330		-148.2	-148.3	-148.5	-147.6	-146.6	-148.5
14	330		-148.8	-148.3	-148.2	-147.3	-146.1	-148.8
15	330		-149.3	149.8	-149.6	145.3	146.9	-149.8
16	330		-149.3	-149.7	-149.5	148.0	-146.9	-149.7
17	330		-149.9	-149.9	-149.9	-148.6	-147.7	-149.9
18	330		-149.6	-149.5	-149.5	-148.5	-147.2	-149.6
19	330		-149.4	-149.1	-149.1	148.0	-147.0	-149.4
20	330		-149.7	-150.1	-150.2	149.2	147.6	-150.2
21	331		-150.8	-151.3	-151.1	-150.2	-148.9	151.4
22	331		-151.1	-151.5	-151.6	150.2	148.8	151.6
23	331	TIME DATA NOT INTERPRETED CORRECTLY BY COMPUTER	151.7	-152.3	-152.5	150.8	-149.4	-152.5
24	331		-151.4	-151.6	-152.0	-150.6	149.3	152.0
25	331		-152.3	-152.5	-152.5	150.7	149.2	52.5
26	331		-150.6	-151.4	-152.0	150.4	-149.1	-152.0
27	331		-149.9	-150.6	-151.6	-150.4	-149.3	-151.6
28	331		-151.6	-151.7	-151.9	150.6	-149.4	-151.9
29	331		-151.2	-151.3	151.3	-149.8	-148.7	-151.3
30	331		-151.7	-152.5	152.6	-150.9	-149.6	-152.6
31	331		-152.4	-153.1	153.3	151.9	-150.5	-153.3
32	331		-153.2	-153.4	-153.9	152.5	-151.2	-153.9
33	331		-153.5	-153.6	-153.9	152.2	-151.0	153.9
34	331		152.8	-153.2	-153.4	151.7	-150.6	153.4
35	331		-152.1	-152.6	-152.8	151.6	150.4	-152.8
36	331		-152.2	-152.5	-152.8	-151.5	-150.2	-152.8
37	331		-152.6	-153.2	-153.5	-151.7	-150.6	-153.5
38	331		-153.0	153.7	-154.4	-152.6	-151.5	-154.4
39	331		-152.6	-153.2	-153.4	-151.9	-150.4	-153.4
40	331		-153.2	-151.0	-154.3	-152.5	-150.6	-154.3
41	331		-153.0	-153.3	-153.6	152.4	-151.1	-153.6
42	331		-152.5	-152.9	153.1	151.3	-149.7	-153.1
43	331		-154.9	-154.7	155.3	-154.4	-153.1	-155.3
44	331		-154.6	-155.3	-155.4	-153.3	152.0	-15 4
45	331		-155.2	-155.8	-155.9	154.4	152.7	-155.9
46	331		-154.8	-155.5	-156.0	-154.7	-153.5	-156.0
47	331		-154.3	-155.7	-155.8	-153.8	152.3	155.8
48	331		154.3	-155.2	155.6	-153.6	-152.9	155.6
49	331		-154.6	-154.8	-155.5	-153.6	152.4	155.5
50	331		-153.3	-153.9	154.6	153.5	-152.4	154.6
51	331		154.1	154.7	154.7	153.0	-151.7	-154.7
52	331		-154.1	-153.9	154.4	-152.8	151.6	154.4
53	331		-151.9	-154.3	-154.5	-152.9	-151.6	154.5
54	331		-154.2	-154.8	-154.8	152.8	151.4	154.8
55	331		-154.2	155.3	155.3	153.1	151.9	-155.3
56	331		153.2	-154.8	-155.4	-153.8	-152.4	-155.4
57	331		152.1	-153.8	-155.3	-153.7	152.0	-155.3
58	331		-154.7	-155.6	155.5	153.6	152.1	-155.6
59	331		154.2	-154.5	155.0	153.7	152.3	155.0
60	331		153.4	-154.5	-155.0	153.6	152.4	155.0
61	331		-154.1	-155.1	155.3	153.7	152.6	-155.3
62	331		-154.8	-155.2	-155.5	-153.8	152.5	155.5
63	331		-154.9	155.1	155.1	153.0	152.2	155.1
64	331		-153.9	154.4	154.6	152.9	151.7	154.6
65	331		153.0	-153.7	-154.4	152.9	151.8	154.4
66	331		-152.7	-153.5	-153.7	-152.1	150.9	153.7
67	331		152.7	-153.6	153.9	152.1	150.9	153.9
68	331		-152.2	152.9	-153.0	151.8	-150.5	153.0
69	331		-151.7	-151.6	-151.6	150.9	-149.7	-151.7
70	331		-152.1	-152.5	-152.4	150.9	149.7	152.5
71	331		151.1	-151.9	151.8	150.2	149.4	151.9
72	331		-151.0	151.0	151.0	149.9	149.0	151.0

Table 21 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 330 and 331, 1975

	1	2	3	4	5	MIN
DAILY MEAN	151.6	152.1	152.3	150.9	149.6	152.3
STANDARD DEV	2.4	2.7	2.9	2.5	2.5	2.8

PROBABILITY DENSITY

156.0	0	0.0	0	0.0	1	1.4	0	0.0	0	0.0	1	1.4
155.0	1	1.4	10	13.9	14	19.4	0	0.0	0	0.0	14	19.4
154.0	15	20.8	9	12.5	10	13.9	3	4.2	0	0.0	10	13.9
153.0	9	12.5	15	20.8	11	15.3	14	19.4	2	2.8	11	15.3
152.0	15	20.8	8	11.1	7	9.7	13	18.1	14	19.4	7	9.7
151.0	8	11.1	9	12.5	9	12.5	8	11.1	11	15.3	9	12.5
150.0	3	4.2	2	2.8	1	1.4	12	16.7	10	13.9	1	1.4
149.0	7	9.7	5	6.9	5	6.9	3	4.2	12	16.7	5	6.9
148.0	4	5.6	5	6.9	4	5.6	4	5.6	3	4.2	5	6.9
147.0	8	11.1	6	8.3	6	8.3	7	9.7	3	4.2	7	9.7
146.0	2	2.8	3	4.2	4	5.6	8	11.1	8	11.1	2	2.8
145.0	0	0.0	0	0.0	0	0.0	0	0.0	6	8.3	0	0.0
144.0	0	0.0	0	0.0	0	0.0	0	0.0	3	4.2	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION

156.0	0	0.0	0	0.0	1	1.4	0	0.0	0	0.0	1	1.4
155.0	1	1.4	10	13.9	15	20.8	0	0.0	0	0.0	15	20.8
154.0	16	22.2	19	26.4	25	34.7	3	4.2	0	0.0	25	34.7
153.0	25	34.7	34	47.2	36	50.0	17	23.6	2	2.8	36	50.0
152.0	40	55.6	42	58.3	43	59.7	30	41.7	16	22.2	43	59.7
151.0	48	66.7	51	70.8	52	72.2	38	52.8	27	37.5	52	72.2
150.0	51	70.8	53	73.6	53	73.6	50	69.4	37	51.4	53	73.6
149.0	58	80.6	58	80.6	58	80.6	53	73.6	49	68.1	58	80.6
148.0	62	86.1	63	87.5	62	86.1	57	79.2	52	72.2	63	87.5
147.0	70	97.2	69	95.8	68	94.4	64	88.9	55	76.4	70	97.2
146.0	72	100.0	72	100.0	72	100.0	72	100.0	63	87.5	72	100.0
145.0	72	100.0	72	100.0	72	100.0	72	100.0	69	95.8	72	100.0
144.0	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0

- Under relatively noisy conditions, there is no regular diurnal variation of best clipping channel, but performance differences among channels separated by 6-18 dB in clipping level are negligible.

- Nonlinear noise processing provides at least 10 dB of improvement over no-prefiltering processing under virtually all noise conditions. An earlier, tentative conclusion by Meyers and Davis (1976) that the improvement may be greater under low-noise conditions than under high-noise conditions is in error.

- Under conditions of vigorously disturbed propagation due to ionospheric instability, clipper performance maintains its improvement in effective noise level. The behavior of the nonlinear noise processor with a disturbed propagation environment is similar to its behavior with a stable propagation environment for low-noise, and high-noise conditions, respectively. This statement should not be construed to indicate, however, that received S/N will be unaffected by propagation disturbance. Considerable evidence indicates that disturbance effects on point-to-point signal propagation and on noise propagation are dissimilar and, perhaps, substantially independent. Examples exist in which signal levels decreased and noise levels increased during ionospheric disturbance, as well as the converse.

Table 22 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 318 and 319, 1975 (Noisy Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO 1 V/m/√Hz) 1	2	3	4	5	MIN
1	318	TIME DATA NOT INTERPRETED CORRECTLY BY COMPUTER	1445	-1443	-1444	[illegible]	1431	-1446
2	318		-1440	-1443	-1442	1447	1433	1443
3	318		-1424	-1435	-1433	-1433	1426	1435
4	318		1434	-1437	-1436	1435	1432	1437
5	318		-1437	1436	-1425	-1436	-1429	1437
6	318		-1433	-1433	-1433	1431	1426	[illegible]
7	318		-1432	-1433	-1433	1433	1425	1433
8	318		-1439	-1443	1441	1449	1435	1443
9	318		-1439	1437	1436	-1435	1430	1439
10	318		-1429	-1430	-1431	1430	1419	1431
11	.8		-1431	-1432	1430	1429	1425	1437
12	.8		-1431	-1432	-1432	1434	1427	1434
13	318		1436	1439	1438	1434	1425	1439
1	318		1440	-1445	1443	1442	1437	1445
15	318		1437	-1437	-1433	1432	1427	1437
16	318		1442	1439	-1436	-1436	-1425	1442
17	318		-1449	-1452	-1451	1447	1437	1452
18	318		1444	-1447	-1446	-1445	1432	1447
19	318		1453	-1451	-1449	1442	1435	1453
20	318		1452	1452	1449	1445	1436	1452
21	318		1453	-1457	-1456	1453	1445	1457
22	318		1458	1459	-1457	1453	1442	-1459
23	318		-1476	1470	-1471	1467	1455	1471
24	319		1473	1472	1472	1470	1459	1472
25	319		1495	1494	-1482	-1477	1462	1495
26	319		1475	-1475	1475	1472	1462	1475
27	319		-1493	-1484	-1482	1477	1466	1494
28	319		-1471	1478	-1474	-1470	1461	1479
29	319		1460	-1468	1465	1463	1459	1468
30	319		-1467	-1467	1468	-1461	-1452	1468
31	319		1467	-1467	-1467	1463	1452	1467
32	319		-1473	-1476	-1473	-1469	1462	1476
33	319		1476	-1490	1477	-1473	1462	1490
34	319		1477	1475	-1477	-1472	1461	1477
35	319		1478	-1481	1479	1474	1464	1481
36	319		1484	1481	1482	1476	1470	1484
37	319		-1488	-1484	1484	1479	-1468	1488
38	319		1485	1486	1486	1479	1467	1486
39	319		1485	1493	1485	1478	1466	1485
40	319		1482	1494	-1484	1476	1466	1484
41	319		1484	-1497	-1485	-1477	1464	1487
42	319		1485	-1495	1486	1485	1474	-1488
43	319		-1493	1495	-1493	-1484	-1476	-1495
44	319		1501	1494	1498	1492	[illegible]	1501
45	319		-1495	-1497	1497	1494	1469	1497
46	319		1500	1499	1502	-1483	1495	1503
47	319		1495	-1496	1498	1487	1474	1498
48	319		-1490	1496	1499	1489	1474	1499
49	319		1491	1494	1497	1498	1473	1497
50	319		1495	-1495	1498	-1491	1473	1498
51	319		-1493	1494	1495	-1483	1473	1495
52	319		-1490	-1489	-1488	-1478	-1459	1490
53	319		1486	1489	1488	1479	1463	1489
54	319		-1486	-1486	-1485	1477	1463	1486
55	319		1488	-1488	1489	1481	1468	1489
56	319		1485	-1485	1486	1476	-1463	1488
57	319		1490	1495	1494	1482	1467	1495
58	319		-1488	1498	1490	1479	1461	1490
59	319		-1482	-1495	1483	1475	1461	1495
60	319		1477	1479	1478	1468	1458	1479
61	319		1474	-1480	1480	1472	1459	1480
62	319		1473	1476	1477	1472	1462	1477
63	319		1472	-1472	-1473	1470	1456	1473
64	319		1466	1467	1464	1464	1456	1467
65	319		-1465	-1462	1463	1459	-1450	1465
66	319		1465	1464	-1466	1460	1449	1466
67	319		1468	1469	-1467	1462	1452	1469
68	319		1461	1466	1469	1462	1444	1469
69	319		1472	1473	-1472	1467	1455	1473
70	319		1470	1475	1475	1467	1454	1475
71	319		1481	1478	1479	1469	1455	1481

Table 23 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 318 and 319, 1975

	1	2	3	4	5	MIN
DAILY MEAN	-146.8	-146.9	-146.9	-146.4	-145.3	-147.0
STANDARD DEV.	2.1	2.1	2.2	1.8	1.7	2.1

PROBABILITY DENSITY

-150.0	1	1.4	0	0.0	1	1.4	0	0.0	0	0.0	2	2.8
-149.0	8	11.3	10	14.1	9	12.7	3	4.2	0	0.0	9	12.7
-148.0	18	25.4	18	25.4	16	22.5	9	12.7	1	1.4	18	25.4
-147.0	14	19.7	13	18.3	15	21.1	21	29.6	8	11.3	12	16.9
-146.0	8	11.3	8	11.3	8	11.3	15	21.1	24	33.8	8	11.3
-145.0	4	5.6	5	7.0	3	4.2	3	4.2	13	18.3	5	7.0
-144.0	5	7.0	5	7.0	7	9.9	8	11.3	5	7.0	6	8.5
-143.0	11	15.5	12	16.9	12	16.9	10	14.1	10	14.1	11	15.5
-142.0	2	2.8	0	0.0	0	0.0	2	2.8	9	12.7	0	0.0
-141.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.4	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION

-150.0	1	1.4	0	0.0	1	1.4	0	0.0	0	0.0	2	2.8
-149.0	9	12.7	10	14.1	10	14.1	3	4.2	0	0.0	11	15.5
-148.0	27	38.0	28	39.4	26	36.6	12	16.9	1	1.4	29	40.8
-147.0	41	57.7	41	57.7	41	57.7	33	46.5	9	12.7	41	57.7
-146.0	49	69.0	49	69.0	49	69.0	48	67.6	33	46.5	49	69.0
-145.0	53	74.6	54	76.1	52	73.2	51	71.8	46	64.8	54	76.1
-144.0	58	81.7	59	83.1	59	83.1	59	83.1	51	71.8	60	84.5
-143.0	69	97.2	71	100.0	71	100.0	69	97.2	61	85.9	71	100.0
-142.0	71	100.0	71	100.0	71	100.0	71	100.0	70	98.6	71	100.0
-141.0	71	100.0	71	100.0	71	100.0	71	100.0	71	100.0	71	100.0

Table 24 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, October and November 1975

CUMULATIVE PROBABILITY DISTRIBUTION

	1		2		3		4		5		MIN	
-157.0	1	0.07	1	0.07	0	0.0	0	0.0	0	0.0	0	0.0
-156.0	1	0.07	3	0.2	1	0.07	0	0.0	0	0.0	4	0.3
-155.0	7	0.5	16	1.2	17	1.3	0	0.0	0	0.0	26	1.9
-154.0	30	2.2	43	3.2	36	2.7	4	0.3	0	0.0	51	3.8
-153.0	69	5.1	100	7.4	76	5.6	21	1.6	2	.15	114	8.4
-152.0	167	12.4	222	16.4	193	14.3	49	3.6	18	1.3	217	16.1
-151.0	318	23.6	369	27.3	348	25.8	119	8.8	35	2.6	395	29.3
-150.0	529	39.2	577	42.7	528	39.1	217	16.1	80	5.9	596	44.1
-149.0	801	59.3	836	61.9	[illegible]	55.7	451	33.4	198	14.7	852	63.1
-148.0	1028	76.2	1037	76.8	994	73.6	652	48.3	364	27.0	1050	77.8
-147.0	1149	85.1	1160	85.9	1141	84.5	903	66.9	568	42.1	1164	86.2
-146.0	1245	92.2	1243	92.1	1234	91.4	1127	83.5	828	61.3	1249	92.5
-145.0	1294	95.8	1299	96.2	1286	95.2	1231	91.2	1070	79.3	1302	96.4
-144.0	1322	97.9	1330	98.5	1321	97.9	1300	96.3	1204	89.2	1331	98.6
-143.0	1345	99.6	1348	99.8	1347	99.8	1337	99.0	1293	95.8	1349	99.9
-142.0	1348	99.8	1350	100.0	1349	99.9	1347	99.8	1331	98.6	1350	100.0
-141.0	1349	99.9	1350	100.0	1349	99.9	1350	100.0	1346	99.7	1350	100.0
-140.0	1349	99.9	1350	100.0	1349	99.9	1350	100.0	1348	99.9	1350	100.0
-139.0	1349	99.9	1350	100.0	1349	99.9	1350	100.0	1349	99.9		
-138.0	1350	100.0	1350	100.0	1350	100.0	1350	100.0	1350	100.0		

EFFECTIVE NOISE LEVEL (DB RELATIVE TO 1 V/m √Hz)

- The data generally tends to confirm that both the diurnal variation and the seasonal dependence of mean effective noise levels, as well as the cumulative probability distribution of data averaged over several weeks, are predictable functions of the solar season.

Finally, it can be concluded that these findings suggest that good nonlinear noise processor performance, under the high-noise conditions that represent the system performance limit, can be provided by a manually adjusted, one- or two-channel signal processor whose clipping levels can be set according to seasonal mean noise level predictions.

In an operational environment, of course, frequency-domain excision may be necessary to deal with cultural noise sources, which are not addressed in this report. Such sources probably vary from receiving platform to receiving platform and, somewhat less probably, from operating theater to operating theater. Frequency-domain excision parameters would thus have to be tailored at least to each platform and would have to be adapted to expected changes in cultural emissions from that platform. Simple, manually operated devices might not suffice for this task. However, in dealing with impulse noise of atmospheric origin, the subject of this report, the data indicate strongly that simple measures can achieve near-optimum performance.

REFERENCES

1. W.D. Meyers and J.R. Davis, "ELF Nonlinear Noise Processing Experimental Measurements, Part 1 - Preliminary Results for July and October 1975," NRL Memorandum Report 3226, Mar. 1976.
2. L.H. Ginsberg, "Extremely Low Frequency (ELF) Atmospheric Noise Level Statistics for Project Sanguine," *IEEE Trans.* COM-22, 555-561 (1974).
3. J.E. Evans and A.S. Griffiths, "Design of a Sanguine Noise Processor Based Upon World-Wide Extremely Low Frequency (ELF) Recordings," *IEEE Trans.* COM-22, 528-539 (1974).